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# NATIONAL GEOGRAPHIC



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Her eyes have captivated the world since she appeared on our cover in 1985. Now we can tell her story.

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### THE COVER

An Afghan woman holds a photograph of herself as a young refugee—a photograph seen by millions, but never, until now, by her.

BY STEVE McCURRY

© Cover printed on recycled-content paper

### ON THE NGM WEBSITE

[nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204)

**SIGHTS & SOUNDS** Meet the woman on our cover and hear how she was identified.

**BATS** and insects make an aerial rendezvous.

**HOTSPOT** Mark Moffett discusses this threatened locale in China.

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# From the Editor



NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN

## Is it really her?

That was the first thing to run through my mind when illustrations editor John Echave told me that a crew from National Geographic EXPLORER had located the "Afghan girl."

The crew was in Pakistan, along with photographer Steve McCurry, looking for the subject of the most famous picture in our magazine's 114-year history: a young Afghan refugee photographed by Steve in 1984. The picture had run on several covers, including our June 1985 issue, our 1994 book *The Photographs*, and, just last fall, our special collector's edition magazine, *100 Best Pictures*. Over the years, Steve and the magazine staff had been besieged with requests for her name and her whereabouts. We knew neither.

Now, perhaps, we had found her. She looked like the same person, but you can't always trust your own eyes. You can trust her eyes, because iris patterns are even more individual than fingerprints. Science would tell us if we had a match.

Pakistani ophthalmologist Mustafa Iqbal examined her in person, comparing her iris patterns and eye freckles with the original photo, and felt "100 percent certain" that she was the same person. Harry Quigley, an ophthalmologist at the Wilmer Eye Institute in Baltimore (above), reviewed photographs of the eyes and said: "It's the same person." Others came to the same conclusion, including FBI forensic examiner Thomas Musheno and Cambridge University professor John Daugman.

After he told us that we had a match, Dr. Quigley asked us, "When will you tell me who this person is?" We invite Dr. Quigley, and all of you who've wondered over the years, to turn the page.

*Bill Allen*



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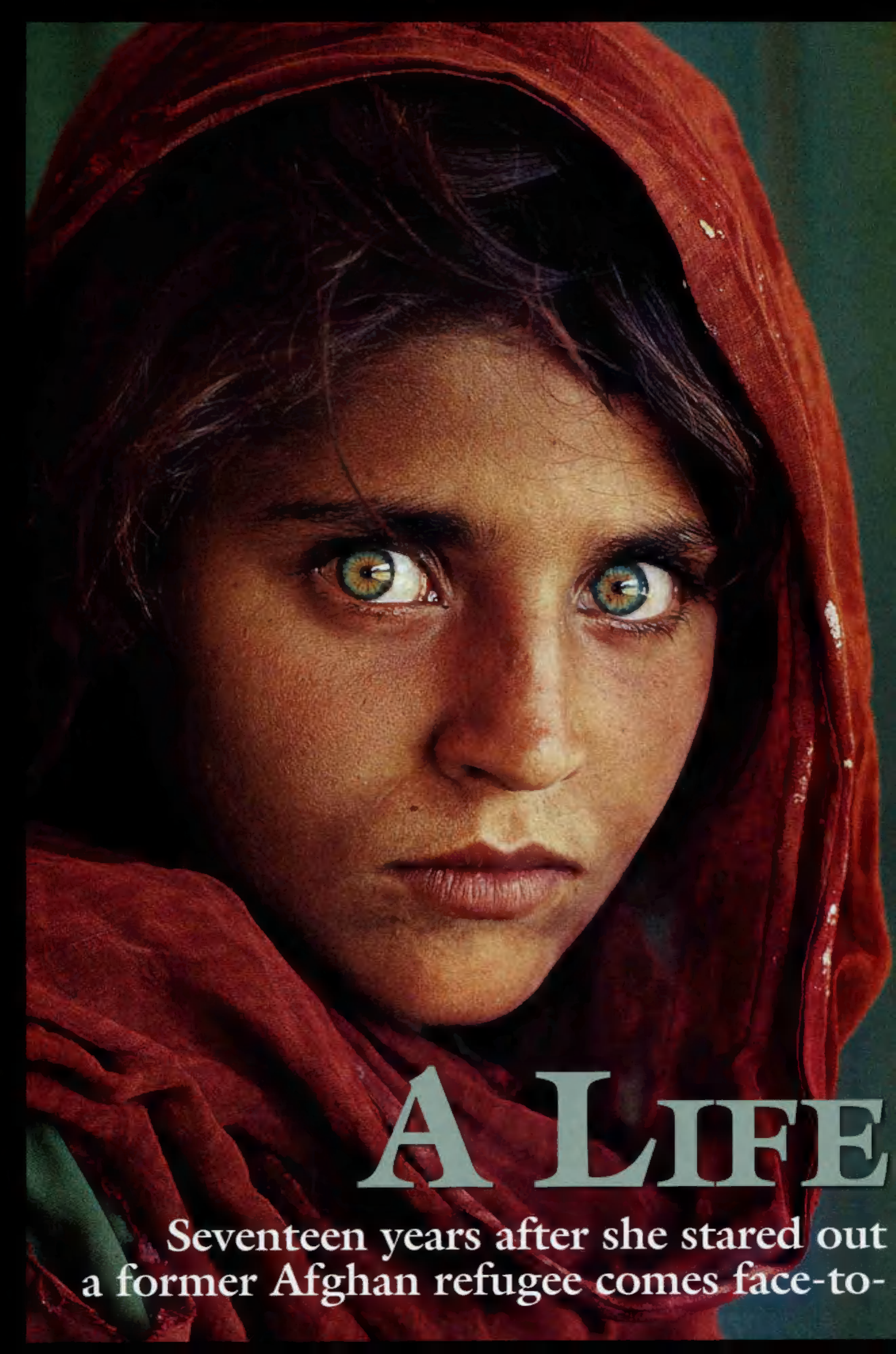
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# ALIE

Seventeen years after she stared out  
a former Afghan refugee comes face-to-





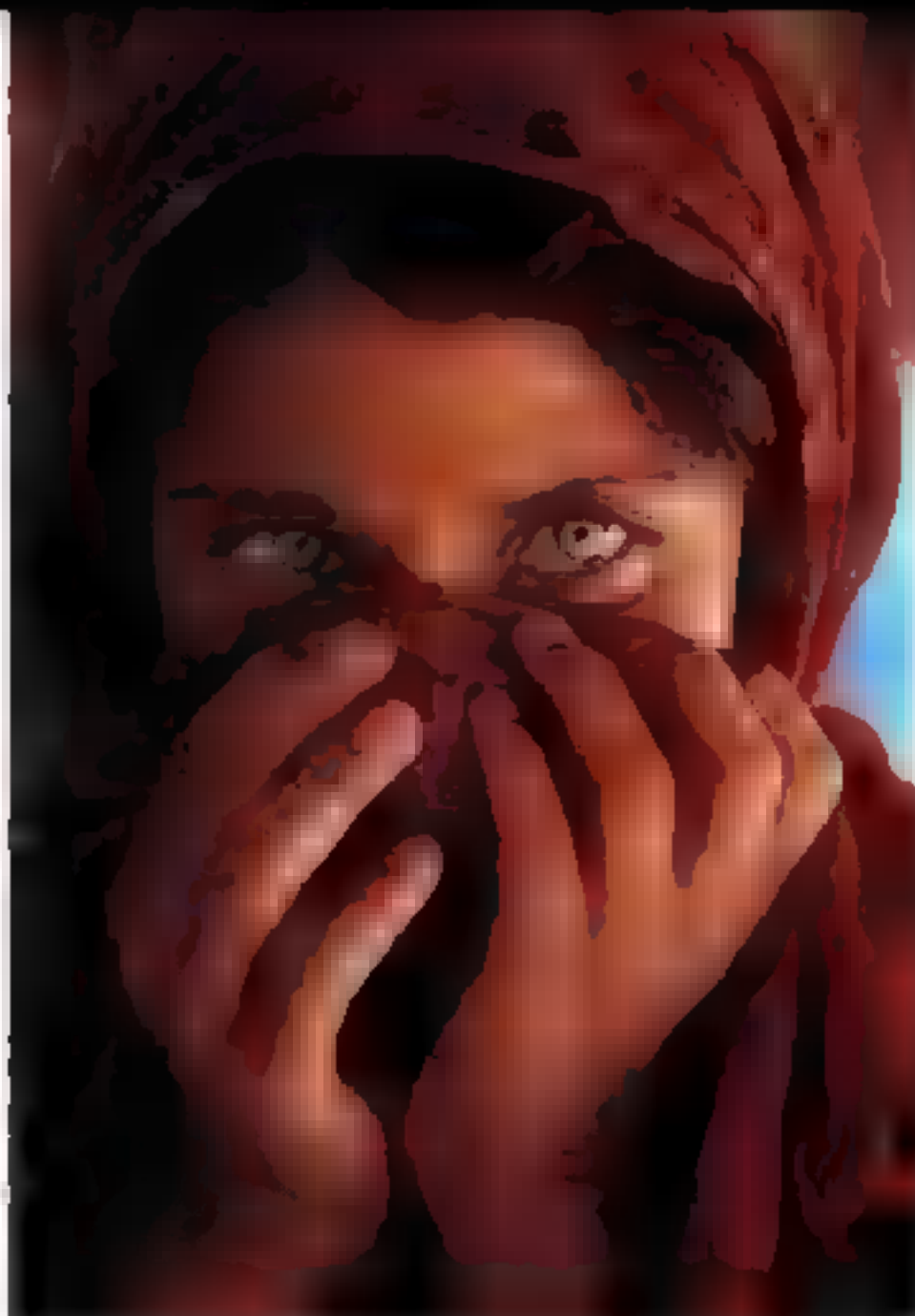
# REVEALED

from the cover of National Geographic,  
face with the world once more.









# She remembers the moment. The photographer took her picture.

She remembers her anger. The man was a stranger. She had never been photographed before. Until they met again 17 years later, she had not been photographed since.

The photographer remembers the moment too. The light was soft. The refugee camp in Pakistan was a sea of tents. Inside the school tent he noticed her first. Sensing her shyness, he approached her last. She told him he could take her picture. "I didn't think the photograph of the girl would be different from anything else I shot that day," he recalls of that morning in 1984 spent documenting the ordeal of Afghanistan's refugees.

The portrait by Steve McCurry turned out to be one of those images that sears the heart, and in June 1985 it ran on the cover of this

**Then and now: As a girl (above) she was photographed by Steve McCurry in a camp in Pakistan for a story on Afghan refugees that ran in the June 1985 issue of NATIONAL GEOGRAPHIC. Today she is the mother of three daughters, including one-year-old Alia.**

magazine. Her eyes are sea green. They are haunted and haunting, and in them you can read the tragedy of a land drained by war. She became known around National Geographic as the "Afghan girl," and for 17 years no one knew her name.

In January a team from National Geographic Television & Film's EXPLORER brought McCurry to Pakistan to search for the girl with green eyes. They showed her picture around Nasir Bagh, the still standing refugee camp near Peshawar where the photograph had been made. A teacher from the school claimed to know her name. A young woman named Alam Bibi was located in a village nearby, but McCurry decided it wasn't her.

No, said a man who got wind of the search.

By **CATHY NEWMAN**  
NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by **STEVE McCURRY**





He knew the girl in the picture. They had lived at the camp together as children. She had returned to Afghanistan years ago, he said, and now lived in the mountains near Tora Bora. He would go get her.

It took three days for her to arrive. Her village is a six-hour drive and three-hour hike across a border that swallows lives. When McCurry saw her walk into the room, he thought to himself: This is her.

Names have power, so let us speak of hers. Her name is Sharbat Gula, and she is Pashtun, that most warlike of Afghan tribes. It is said of the Pashtun that they are only at peace when they are at war, and her eyes—then and now—burn with ferocity. She is 28, perhaps 29, or even 30. No one, not even she, knows for sure. Stories shift like sand in a place where no records exist.

Time and hardship have erased her youth. Her skin looks like leather. The geometry of her jaw has softened. The eyes still glare; that

**A family portrait shows, from left to right, three-year-old daughter Zahida, husband Rahmat Gul, Sharbat Gula, Alia, and Sharbat's older brother, Kashar Khan.**

**To help McCurry and the TV crew locate her, elders from the Nasir Bagh refugee camp (right) circulated McCurry's photograph.**

has not softened. "She's had a hard life," said McCurry. "So many here share her story." Consider the numbers. Twenty-three years of war, 1.5 million killed, 3.5 million refugees: This is the story of Afghanistan in the past quarter century.

Now, consider this photograph of a young girl with sea green eyes. Her eyes challenge ours. Most of all, they disturb. We cannot turn away.

"THERE IS NOT ONE FAMILY that has not eaten the bitterness of war," a young Afghan merchant said in the 1985 NATIONAL GEOGRAPHIC story that appeared with Sharbat's photograph on the cover. She was a child when her country was caught in the jaws of the Soviet invasion. A carpet of destruction smothered countless villages like hers. She was perhaps six when Soviet bombing killed her parents. By day the sky bled terror. At night the dead were buried. And always, the sound of planes, stabbing her with dread.



"We left Afghanistan because of the fighting," said her brother, Kashar Khan, filling in the narrative of her life. He is a straight line of a man with a raptor face and piercing eyes. "The Russians were everywhere. They were killing people. We had no choice."

Shepherded by their grandmother, he and his four sisters walked to Pakistan. For a week they moved through mountains covered in snow, begging for blankets to keep warm.

"You never knew when the planes would come," he recalled. "We hid in caves."

hope," said Yusufzai. "Each time, the Afghan people have found themselves betrayed by their leaders and by outsiders professing to be their friends and saviors."

In the mid-1990s, during a lull in the fighting, Sharbat Gula went home to her village in the foothills of mountains veiled by snow. To live in this earthen-colored village at the end of a thread of path means to scratch out an existence, nothing more. There are terraces planted with corn, wheat, and rice, some walnut trees, a stream that spills down the moun-

tain (except in times of drought), but no school, clinic, roads, or running water.

Here is the bare outline of her day. She rises before sunrise and prays. She fetches water from the stream. She cooks, cleans, does laundry. She cares for her children; they are the center of her life. Robina is 13. Zahida is three. Alia, the baby, is one. A fourth daughter died in infancy. Sharbat has never known a happy day, her brother says, except perhaps the day of her marriage.

Her husband, Rahmat Gul, is slight in build,

with a smile like the gleam of a lantern at dusk. She remembers being married at 13. No, he says, she was 16. The match was arranged.

He lives in Peshawar (there are few jobs in Afghanistan) and works in a bakery. He bears the burden of medical bills; the dollar a day he earns vanishes like smoke. Her asthma, which cannot tolerate the heat and pollution of Peshawar in summer, limits her time in the city and with her husband to the winter. The rest of the year she lives in the mountains.

At the age of 13, Yusufzai, the journalist, explained, she would have gone into purdah, the secluded existence followed by many Islamic women once they reach puberty. "Women vanish from the public eye," he said. In the street she wears a plum-colored burka,



The journey that began with the loss of their parents and a trek across mountains by foot ended in a refugee camp tent living with strangers.

"Rural people like Sharbat find it difficult to live in the cramped surroundings of a refugee camp," explained Rahimullah Yusufzai, a respected Pakistani journalist who acted as interpreter for McCurry and the television crew. "There is no privacy. You live at the mercy of other people." More than that, you live at the mercy of the politics of other countries. "The Russian invasion destroyed our lives," her brother said.

It is the ongoing tragedy of Afghanistan. Invasion. Resistance. Invasion. Will it ever end? "Each change of government brings





## The eyes have it

To verify that Sharbat Gula was indeed the young Afghan girl photographed by McCurry, Thomas Musheno, a forensic examiner for the Federal Bureau of Investigation (above) did a facial comparison between photographs taken in late 1984 and those taken recently. "I'm 100

percent sure this is the same person," he said.

The inventor of automatic iris recognition, John Daugman, a professor of computer science at Cambridge University, England, mathematically determined that the eyes belong to the same person. Iris patterns, like fingerprints, are unique and can be used for identification.



NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN (ABOVE LEFT); ALEXANDRA BOULAT

which walls her off from the world and from the eyes of any man other than her husband. "It is a beautiful thing to wear, not a curse," she says.

Faced by questions, she retreats into the black shawl wrapped around her face, as if by doing so she might will herself to evaporate. The eyes flash anger. It is not her custom to subject herself to the questions of strangers.

Had she ever felt safe?

"No. But life under the Taliban was better. At least there was peace and order."

Had she ever seen the photograph of herself as a girl?

"No."

She can write her name, but cannot read. She harbors the hope of education for her children. "I want my daughters to have skills," she said. "I wanted to finish school but could not. I was sorry when I had to leave."

Education, it is said, is the light in the eye. There is no such light for her. It is possibly

### MORE ON OUR WEBSITE

**SIGHTS ■ SOUNDS** Immerse yourself in the quest to find the "Afghan girl" in this narrative multimedia special. Also view video from the National Geographic EXPLORER show. (See local listings for repeat airings on MSNBC and internationally on the National Geographic Channel.) Check out field tales from the TV team and Steve McCurry, and the June 1985 story at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204).

too late for her 13-year-old daughter as well, Sharbat Gula said. The two younger daughters still have a chance.

**THE REUNION** between the woman with green eyes and the photographer was quiet. On the subject of married women, cultural tradition is strict. She must not look—and certainly must not smile—at a man who is not her husband. She did not smile at McCurry. Her expression, he said, was flat. She cannot understand how her picture has touched so many. She does not

know the power of those eyes.

Such knife-thin odds. That she would be alive. That she could be found. That she could endure such loss. Surely, in the face of such bitterness the spirit could atrophy. How, she was asked, had she survived?

The answer came wrapped in unshakable certitude.

"It was," said Sharbat Gula, "the will of God."





PHOTOGRAPHER STEVE McCURRY © 2002

By STEVE McCURRY

## I could see her eyes through the camera lens. They're still the same.

Her skin is weathered, there are wrinkles now, but she's as striking as the young girl I photographed 17 years ago. Both times our connection was through the lens. This time she found it easier to look into the lens than at me. She is a married woman and must not look at a man who is not her husband.

Our conversation was brief. There was little emotion. I explained that so many had been moved by her photograph. I've received countless letters from people around the world who were inspired by the photograph to volunteer in refugee camps or do aid work in Afghanistan. When she saw the photo for the first time, she was embarrassed by the holes in her red shawl. A cooking fire had burned it, she said. She is glad her picture was an inspiration. But I don't think the photograph means anything to her. The only thing that matters is her husband and children.

I remember the noise and confusion in that refugee camp 17 years ago. I knew that Afghan girls, just a few years away from disappearing behind a traditional veil, might be reluctant to have their picture taken by a male Westerner. So I proceeded carefully. I asked the teacher for permission to enter the girls' school tent and photograph a few of the students. The

shyest of them, Sharbat, said I could take her photograph, and I shot a few frames.

When I saw the film, I was surprised by how still and quiet it appeared. At that point the Soviets had been in Afghanistan for five years. So it was a specific moment in time. Yet it was a timeless moment. There's the idea that this image was emblematic for what was happening in Afghanistan. But a lot of people don't know the picture is related to Afghanistan, and they still respond to that look.

I'm relieved to know that this young woman has survived and has been able to carve out a life for herself. I hope that finding her will be a good thing for her and her family. I'd like her to look back in ten years and be happy this happened. I intend to check in on her for the rest of my life.

It's fortunate we found her now. The local government is going to rip down the refugee camp and build a housing development. If we had tried to do this a year from now, it would have been impossible. Only through contacts in the camp were we able to locate her. Afghanistan has been in a Dark Age for two decades. That she's resurfaced now is perhaps prophetic, a hopeful sign. We'll have to wait and see. □

### NATIONAL GEOGRAPHIC SOCIETY'S AFGHAN GIRLS FUND

Many women in Afghanistan want the same thing for their daughters that Sharbat Ghalibai wants for hers: an education. The National Geographic Society has decided to create the Afghan Girls Fund. The Society will work with select nonprofit organizations to fund educational opportunities for the girls and young women of Afghanistan. You are welcome to participate by going to [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204) or sending a check directly to the Afghan Girls Fund, Development Office, National Geographic Society, 1145 17th Street NW, Washington, DC 20036.



# Forum

## December 2001

The death of a seal pup in Antarctica and the perils of prosperity in Silicon Valley drew passionate responses from our readers. But no piece drew more mail than our article on Abraham. "It is fact that many atrocities have been committed in the name of religion," wrote a reader. "It is also fact that some of the greatest works of benevolence and deeds of mercy . . . have been done in the name of religion."



## Antarctica

I would like to know the story behind the Weddell seal pup on pages 10-11. I cannot believe that an exceptional organization like National Geographic would not intervene on the pup's behalf. To allow an abandoned pup to wander off and die is inhumane.

NANCY J. CRIDER  
El Paso, Texas

"Even though I'd learned that only half of Weddell seals survive their first year, it was very upsetting," says photographer Maria Stenzel. The international Antarctic Treaty prohibits interfering with wildlife without a research permit, which Maria did not have. Nor could the scientist accompanying Maria legally euthanize the pup, as some readers have suggested would have been humane. The pup attempted to join other pups and mothers nearby but was rejected when it tried to suckle. Adoption is rare; each mother has only one pup a year, and enough milk and energy for that pup.

### MORE INFORMATION

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The caption on page 27 states that the giant petrel was banded in 1979. Does this bird really survive that long?

GARY LEVESQUE  
Tucson, Arizona

The life span of the giant petrel has not been documented, but ornithologists presume that individuals may live well past 40, as do albatrosses, also members of the order Procellariiformes.

I greatly enjoyed the Antarctica article. I was surprised to learn on page 12 that Erebus has "one of the few permanent lava lakes in the world." I eagerly awaited the names of the others but was disappointed. So what are they?

ANN STILLWATER  
Bowerston, Ohio

There are also permanent lava lakes in the Rift Valley volcanoes Erta'ale in Ethiopia and Nyiragongo in the Democratic Republic of the Congo, which erupted so devastatingly in late January.

## Journey of Faith

Tad Szulc's article on Abraham was the best I've ever read on the subject. It should be required reading for Israelis, Palestinians, and anyone who cares about peace in the Middle East. The



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Before  
**nasal allergies**  
change your life



Make  
an easier  
**Change**



**Nasal allergies can be so frustrating, you want to plow down your whole yard.**

Of course, you would never go to these extremes. But before you change your life, maybe you should make an easier change. Ask your doctor about FLONASE.

Using multi-symptom FLONASE Nasal Spray once a day can relieve all these nasal allergy symptoms—congestion, sneezing, and itchy, runny nose—all day and night. Results may vary.

If side effects occur, they are generally mild, and may include headache, nosebleed, or sore throat. For best results, use daily. Maximum relief may take several days. Available by prescription only.

Ask your doctor about multi-symptom FLONASE, or call 1-800-FLONASE, or visit [www.flonase.com](http://www.flonase.com).

When you get it all, all it takes is **Flonase**<sup>®</sup>  
(fluticasone propionate)  
**Nasal Spray, 50 mcg**



GlaxoSmithKline

Please see important information on the following page.



**FLONASE®**  
(fluticasone propionate)  
Nasal Spray, 50 mcg

**BRIEF SUMMARY**

**SHAKE GENTLY  
BEFORE USE.**

**For Intranasal Use Only.**

The following is a brief summary only; see full prescribing information for complete product information.

**CONTRAINDICATIONS:** FLONASE Nasal Spray is contraindicated in patients with a hypersensitivity to any of its ingredients.

**WARNINGS:** The replacement of a systemic corticosteroid with a topical corticosteroid can be accompanied by signs of adrenal insufficiency, and in addition some patients may experience symptoms of withdrawal (e.g., joint and/or muscular pain, lassitude, and depression). Patients previously treated for prolonged periods with systemic corticosteroids and transferred to topical corticosteroids should be carefully monitored for acute adrenal insufficiency in response to stress. In those patients who have asthma or other clinical conditions requiring long-term systemic corticosteroid treatment, too rapid a decrease in systemic corticosteroids may cause a severe exacerbation of their symptoms.

The concomitant use of intranasal corticosteroids with other inhaled corticosteroids could increase the risk of signs or symptoms of hypercorticism and/or suppression of the HPA axis.

Patients who are on immunosuppressant drugs are more susceptible to infections than healthy individuals. Chickenpox and measles, for example, can have a more serious or even fatal course in patients on immunosuppressant doses of corticosteroids. In such patients who have not had these diseases, particular care should be taken to avoid exposure. How the dose, route, and duration of corticosteroid administration affects the risk of developing a disseminated infection is not known. The contribution of the underlying disease and/or prior corticosteroid treatment to the risk is also not known. If exposed to chickenpox, prophylaxis with varicella-zoster immune globulin (VZIG) may be indicated. If exposed to measles, prophylaxis with pooled intramuscular immunoglobulin (IG) may be indicated. (See the respective package inserts for complete VZIG and IG prescribing information.) If chickenpox develops, treatment with antiviral agents may be considered.

**PRECAUTIONS:**

**General:** Rarely, immediate hypersensitivity reactions or contact dermatitis may occur after the administration of FLONASE Nasal Spray. Rare instances of wheezing, nasal septum perforation, cataracts, glaucoma, and increased intraocular pressure have been reported following the intranasal application of corticosteroids, including fluticasone propionate.

Use of excessive doses of corticosteroids may lead to signs or symptoms of hypercorticism: suppression of HPA function, and/or reduction of growth velocity in children or teenagers. Physicians should closely follow the growth of children and adolescents taking corticosteroids, by any route, and weigh the benefits of corticosteroid therapy against the possibility of growth suppression if growth appears slowed.

Although systemic effects have been minimal with recommended doses of FLONASE Nasal Spray, potential risk increases with larger doses. Therefore, larger than recommended doses of FLONASE Nasal Spray should be avoided.

When used at higher than recommended doses, or in rare individuals at recommended doses, systemic corticosteroid effects such as hypercorticism and adrenal suppression may appear. If such changes occur, the dosage of FLONASE Nasal Spray should be discontinued slowly consistent with accepted procedures for discontinuing oral corticosteroid therapy.

In clinical studies with fluticasone propionate administered intranasally, the development of localized infections of the nose and pharynx with *Candida albicans* has occurred only rarely. When such an infection develops, it may require treatment with appropriate local therapy and discontinuation of treatment with FLONASE Nasal Spray. Patients using FLONASE Nasal Spray over several months or longer should be examined periodically for evidence of *Candida* infection or other signs of adverse effects on the nasal mucosa.

FLONASE Nasal Spray should be used with caution, if at all, in patients with active or quiescent tuberculous infection, untreated local or systemic fungal or bacterial, or systemic viral infections or parasitic infection, or ocular herpes simplex.

Because of the inhibitory effect of corticosteroids on wound healing, patients who have experienced recent nasal septal ulcers, nasal surgery, or nasal trauma should not use a nasal corticosteroid until healing has occurred.

**Information for Patients:** Patients being treated with FLONASE Nasal Spray should receive the following information and instructions. This information is intended to aid them in the safe and effective use of this medication. It is not a disclosure of all possible adverse or intended effects.

Patients should be warned to avoid exposure to chickenpox or measles and, if exposed, to consult their physician without delay.

Patients should use FLONASE Nasal Spray at regular intervals as directed since its effectiveness depends on its regular use. A decrease in nasal symptoms may occur as soon as 12 hours after starting therapy with FLONASE Nasal Spray. Results in several clinical trials indicate statistically significant improvement within the first day or two of treatment, however, the full benefit of FLONASE Nasal Spray may not be achieved until treatment has been administered for several days. The patient should not increase the prescribed dosage but should contact the physician if symptoms do not improve or if the condition worsens. For the proper use of the nasal spray and to attain maximum improvement, the patient should read and follow carefully the accompanying patient's instructions.

**Drug Interactions:** In a placebo-controlled, crossover study in 8 healthy volunteers, coadministration of a single dose of orally inhaled fluticasone propionate (1000 mcg, 5 times the maximum daily intranasal dose) with multiple doses of ketoconazole (200 mg) to steady state resulted in increased mean fluticasone propionate concentrations, a reduction in plasma cortisol AUC, and no effect on urinary excretion of cortisol. This interaction may be due to an inhibition of the cytochrome P450 3A4 isoenzyme system by ketoconazole, which is also the route of metabolism of fluticasone propionate. No drug interaction studies have been conducted with FLONASE Nasal Spray; however, care should be exercised when fluticasone propionate is coadministered with long-term ketoconazole and other known cytochrome P450 3A4 inhibitors.

**Carcinogenesis, Mutagenesis, Impairment of Fertility:** Fluticasone propionate demonstrated no tumorigenic potential in mice at oral doses up to 1000 mcg/kg (approximately 20 times the maximum recommended daily intranasal dose in adults and approximately 10 times the maximum recommended daily intranasal dose in children on a mcg/m<sup>3</sup> basis) for 78 weeks or in rats at inhalation doses up to 57 mcg/kg (approximately 2 times the maximum recommended daily intranasal dose in adults and approximately equivalent to the maximum recommended daily intranasal dose in children on a mcg/m<sup>3</sup> basis) for 104 weeks.

Fluticasone propionate did not induce gene mutation in prokaryotic or eukaryotic cells in vitro. No significant clastogenic effect was seen in cultured human peripheral lymphocytes in vitro or in the mouse micronucleus test when administered at high doses by the oral or subcutaneous routes. Furthermore, the compound did not delay erythroblast division in bone marrow.

No evidence of impairment of fertility was observed in reproductive studies conducted in male and female rats at subcutaneous doses up to 50 mcg/kg (approximately 2 times the maximum recommended daily intranasal dose in adults on a mcg/m<sup>3</sup> basis). Prostate weight was significantly reduced at a subcutaneous dose of 50 mcg/kg.

**Pregnancy, Teratogenic Effects:** Pregnancy Category C. Subcutaneous studies in the mouse and rat at 45 and 100 mcg/kg, respectively (approximately equivalent to and 4 times the maximum recommended daily intranasal dose in adults on a mcg/m<sup>3</sup> basis, respectively) revealed fetal toxicity characteristic of potent corticosteroid compounds, including embryonic growth retardation, omphalocele, cleft palate, and retarded cranial ossification.

In the rabbit, fetal weight reduction and cleft palate were observed at a subcutaneous dose of 4 mcg/kg (less than the maximum recommended daily intranasal dose in adults on a mcg/m<sup>3</sup> basis).

However, no teratogenic effects were reported at oral doses up to 300 mcg/kg (approximately 25 times the maximum recommended daily intranasal dose in adults on a mcg/m<sup>3</sup> basis) of fluticasone propionate to the rabbit. No fluticasone propionate was detected in the plasma in this study, consistent with the established low bioavailability following oral administration (see CLINICAL PHARMACOLOGY section of full prescribing information).

**FLONASE® (fluticasone propionate) Nasal Spray, 50 mcg**

Fluticasone propionate crossed the placenta following oral administration of 100 mcg/kg to rats or 300 mcg/kg to rabbits (approximately 4 and 25 times, respectively, the maximum recommended daily intranasal dose in adults on a mcg/m<sup>3</sup> basis).

There are no adequate and well-controlled studies in pregnant women. Fluticasone propionate should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Experience with oral corticosteroids since their introduction as pharmacologic, as opposed to physiologic, doses suggests that rodents are more prone to teratogenic effects from corticosteroids than humans. In addition, because there is a natural increase in corticosteroid production during pregnancy, most women will require a lower exogenous corticosteroid dose and many will not need corticosteroid treatment during pregnancy.

**Nursing Mothers:** It is not known whether fluticasone propionate is excreted in human breast milk. When tritiated fluticasone propionate was administered to rats at a subcutaneous dose of 10 mcg/kg (less than the maximum recommended daily intranasal dose in adults on a mcg/m<sup>3</sup> basis), radioactivity was excreted in the milk. Because other corticosteroids are excreted in human milk, caution should be exercised when FLONASE Nasal Spray is administered to a nursing woman.

**Pediatric Use:** Five hundred (500) patients aged 4 to 11 years of age and 440 patients aged 12 to 17 years were studied in US clinical trials with fluticasone propionate nasal spray. The safety and effectiveness of FLONASE Nasal Spray in children below 4 years of age have not been established.

Oral and, to a less clear extent, inhaled and intranasal corticosteroids have been shown to have the potential to cause reduction in growth velocity in children and adolescents with extended use. If a child or adolescent on any corticosteroid appears to have growth suppression, the possibility that they are particularly sensitive to this effect of corticosteroids should be considered (see PRECAUTIONS).

**Geriatric Use:** A limited number of patients above 60 years of age (n=275) have been treated with FLONASE Nasal Spray in US and non-US clinical trials. While the number of patients is too small to permit separate analyses of efficacy and safety, the adverse reactions reported in this population were similar to those reported by younger patients.

**ADVERSE REACTIONS:** In controlled US studies, more than 3300 patients with seasonal allergic, perennial allergic, or perennial nonallergic rhinitis received treatment with intranasal fluticasone propionate. In general, adverse reactions in clinical studies have been primarily associated with irritation of the nasal mucous membranes and the adverse reactions were reported with approximately the same frequency by patients treated with the vehicle itself. The complaints did not usually interfere with treatment. Less than 2% of patients in clinical trials discontinued because of adverse events; this rate was similar for vehicle placebo and active comparators.

Systemic corticosteroid side effects were not reported during controlled clinical studies up to 6 months' duration with FLONASE Nasal Spray. If recommended doses are exceeded, however, or if individuals are particularly sensitive or taking FLONASE Nasal Spray in conjunction with administration of other corticosteroids, symptoms of hypercorticism (e.g., Cushing's syndrome), could occur.

The following incidence of common adverse reactions (>3%, where incidence in fluticasone propionate-treated subjects exceeded placebo) is based upon 7 controlled clinical trials in which 536 patients (57 girls and 108 boys aged 4-11 years, 137 female and 234 male adolescents and adults) were treated with FLONASE Nasal Spray 200 mcg once daily over 2 to 4 weeks and 2 controlled clinical trials in which 246 patients (119 female and 127 male adolescents and adults) were treated with FLONASE Nasal Spray 200 mcg once daily over 6 months. Also included in the table are adverse events from 2 studies in which 167 children (45 girls and 122 boys aged 4-11 years) were treated with FLONASE Nasal Spray 100 mcg once daily for 2 to 4 weeks.

**Overall Adverse Experiences With >3% Incidence on Fluticasone Propionate in Controlled Clinical Trials With FLONASE Nasal Spray in Patients ≥4 Years With Seasonal or Perennial Allergic Rhinitis**

Adverse Experience	Vehicle Placebo (n=758) %	FLONASE 100 mcg Once Daily (n=167) %	FLONASE 200 mcg Once Daily (n=782) %
Headache	14.6	6.6	16.1
Pharyngitis	7.2	6.0	7.8
Epistaxis	5.4	6.0	6.9
Nasal burning/ nasal irritation	2.6	2.4	3.2
Nausea/vomiting	2.0	4.8	2.6
Asthma symptoms	2.9	7.2	3.3
Cough	2.8	3.6	3.8

Other adverse events that occurred in ≤3% but ≥1% of patients and that were more common with fluticasone propionate (with uncertain relationship to treatment) included blood in nasal mucus, runny nose, abdominal pain, diarrhea, fever, flu-like symptoms, aches and pains, dizziness, bronchitis.

**Observed During Clinical Practice:** In addition to adverse events reported from clinical trials, the following events have been identified during postapproval use of fluticasone propionate in clinical practice. Because they are reported voluntarily from a population of unknown size, estimates of frequency cannot be made. These events have been chosen for inclusion due to either their seriousness, frequency of reporting, causal connection to fluticasone propionate, occurrence during clinical trials, or a combination of these factors.

**General:** Hypersensitivity reactions, including angioedema, skin rash, edema of the face and tongue, pruritus, urticaria, bronchospasm, wheezing, dyspnea, and anaphylaxis/anaphylactoid reactions, which in rare instances were severe.

**Ear, Nose, and Throat:** Alteration or loss of sense of taste and/or smell and, rarely, nasal septal perforation, nasal ulcer, sore throat, throat irritation and dryness, cough, hoarseness, and voice changes.

**Eye:** Dryness and irritation, conjunctivitis, blurred vision, glaucoma, increased intraocular pressure and cataracts.

**OVERDOSAGE:** Chronic overdosage with FLONASE Nasal Spray may result in signs/symptoms of hypercorticism (see PRECAUTIONS). Intranasal administration of 2 mg (10 times the recommended dose) of fluticasone propionate twice daily for 7 days to healthy human volunteers was well tolerated. Single oral doses up to 16 mg have been studied in human volunteers with no acute toxic effects reported. Repeat oral doses up to 80 mg daily for 10 days in volunteers and repeat oral doses up to 10 mg daily for 14 days in patients were well tolerated. Adverse reactions were of mild or moderate severity, and incidences were similar in active and placebo treatment groups. Acute overdosage with this dosage form is unlikely since 1 bottle of FLONASE Nasal Spray contains approximately 8 mg of fluticasone propionate.

The oral and subcutaneous median lethal doses in mice and rats were >1000 mg/kg (>20,000 and >41,000 times, respectively, the maximum recommended daily intranasal dose in adults and >10,000 and >20,000 times, respectively, the maximum recommended daily intranasal dose in children on a mcg/m<sup>3</sup> basis).



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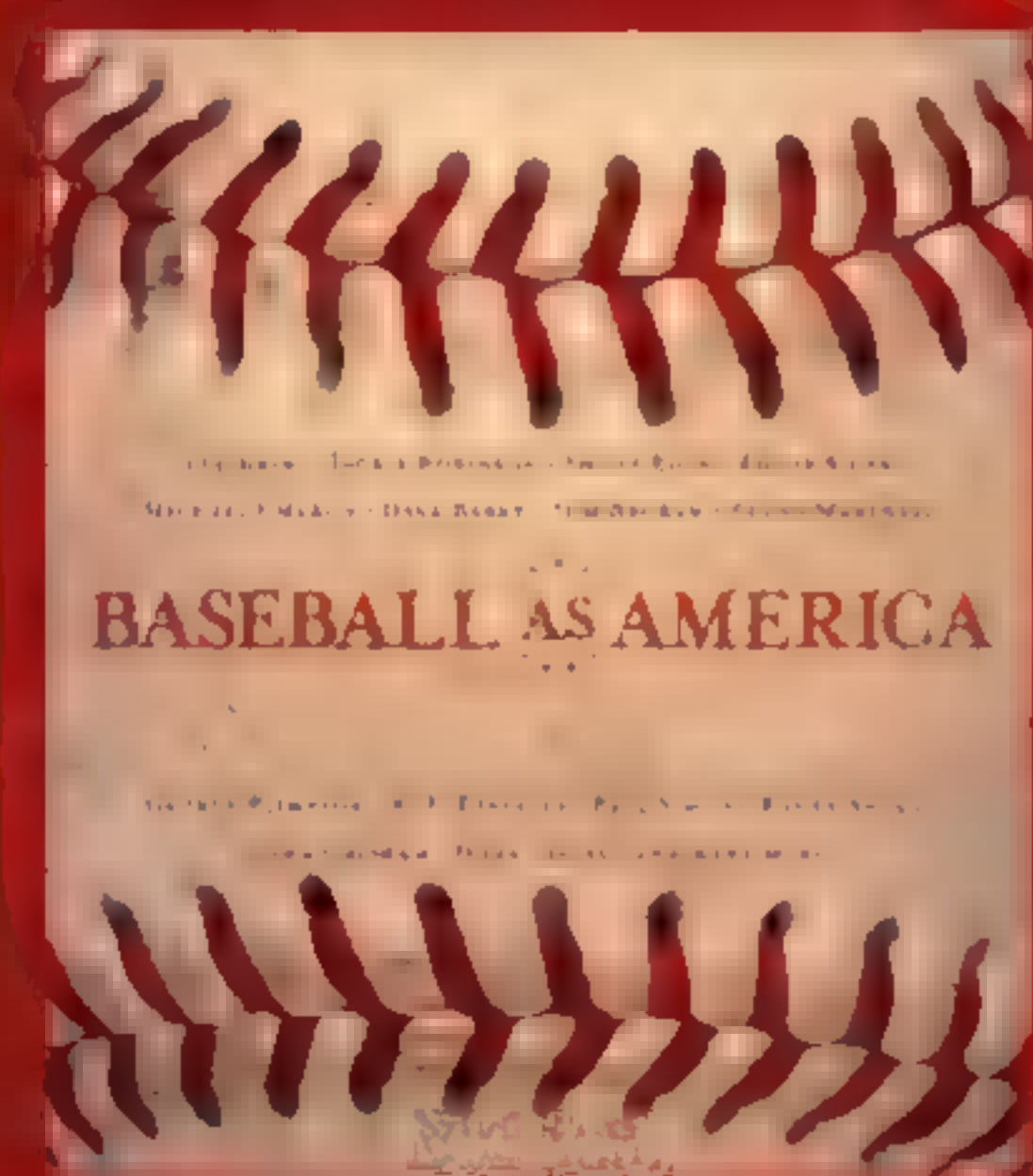
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February 2002



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**Afghanistan**

Congratulations on the map of Afghanistan. The map stays where I watch television, and it is a pleasure to pick it up and document where the action is.

ANNABEL GIRARD  
*Danville, Kentucky*

I am concerned about the heroizing of Ahmad Shah Massoud [right]. His forces have been accused of brutal human rights violations in the past, just as the Taliban has been. The Northern Alliance is only an alliance in name, formed against the common threat of the Taliban and composed of a number of rival groups who would otherwise be competing for power with each other. What is needed is a measured view

of military allies that exposes their ugly sides as well as their pleasant ones.

ADAM McCONNEL  
*Istanbul, Turkey*

I admire Edward Girardet for a job well done on Afghanistan. I was touched by the lives of the Afghan people under the cruel hands of the Taliban. I hope people will unite and continue to help them improve their lives and become completely free from the bondage that hinders their development and well-being. I didn't know the real story there until I read Girardet's article.

DIANA D. ADORABLE  
*Naga, Philippines*

In 1972 I was visiting Afghanistan, and my best memory is



a stay near the wonderful lakes of Band-e Amir, west of Bamian. A river ran through a chalky white mountain, forming a chain of five lakes. The blue water was so transparent that I could see trout on the bottom.

MONIQUE LAURENT  
*Frontenas, France*

story begins with words that sadly are nearly as true today as in 2000 B.C.: "Imagine a world saturated with ignorance and hatred . . . without any hope of redemption." We Christians, Jews, and Muslims would do well to emulate Abraham and his obedience, for God wants us all to live in peace and harmony.

DON GRAHAM  
*Green Lane, Pennsylvania*

It is easy to see today that indeed the five simple words "My God will save me" have changed the world. Unfortunately, with many of Abraham's offspring enveloping the world in their mutual

hatred and killing in the name of "my God," it is hard to argue that such a belief has changed the world for the better.

TOM LYNCH  
*Atlanta, Georgia*

The caption on pages 124-5 misleadingly characterizes Hamas, the Islamic Resistance Movement, as a group that seeks "to force the 'Zionist entity' out of Palestine." Based on my own and other journalists' interviews in the area, I'd say it's more accurate to describe it as a Palestinian grassroots organization whose goal is to end Israel's 34-year-old military occupation of the West Bank, East Jerusalem, and Gaza so that a viable Palestinian state can be established alongside Israel. Of course, the terrorism Hamas's military wing often employs should be deplored, just as should Israel's state terrorism.

ROGER GAESS  
*New York, New York*

Your use of Rembrandt's "Sacrifice of Isaac" on the cover summarizes the key moral concepts of the three great faiths: obedience (Judaism), submission (Islam), and mercy (Christianity). The values are embodied, respectively, in the figures of Abraham, Isaac, and the angel.

THOMAS A. REISNER  
*St.-Lambert-de-Lévis, Quebec*

On page 127 the author writes of how Sarah acted independently of Abraham: "I asked him if this makes Sarah the first great feminist. 'Yes,' the rabbi shot back." But my question is: What about mother Eve?

VERDE HUGHES  
*Mesquite, Nevada*

As a retired Episcopal priest and sometime college instructor in the humanities and world religion, I found the article on Abraham to be brilliantly written. But to give credit where credit is due,


National Geographic Magazine, PO Box 98199, Washington, DC 20090-8199, or by fax to 202-828-5460, or via the Internet to [ngsforum@nationalgeographic.com](mailto:ngsforum@nationalgeographic.com). Include name, address, and daytime telephone. Letters may be edited for clarity and space.





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may I suggest that the first undeniably historic figure to proclaim monotheism, rather than assume or inherit it, was the "heretic pharaoh" Akhenaten. His banishment of all other gods in the Egyptian pantheon in favor of the Aten, or sun disk, earned him the enmity of the religious establishment.

FRANK CARSON KNEBEL  
*San Diego, California*

It does seem as if we are branches of the same family squabbling among ourselves.

L. MARGARET DYKES  
*Johnson City, Tennessee*

**Silicon Valley**

Living in your cubicle? Being homeless despite earning \$105,000 a year? Constantly

networking without really getting to know anyone? I made less than \$20,000 last year, and I feel positively rich compared with these people. Talk about the pretty landscape and the nice weather all you want. Silicon Valley sounds like ■ man-made hell on Earth to me.

TIMOTHY WHITE  
*Chicago, Illinois*

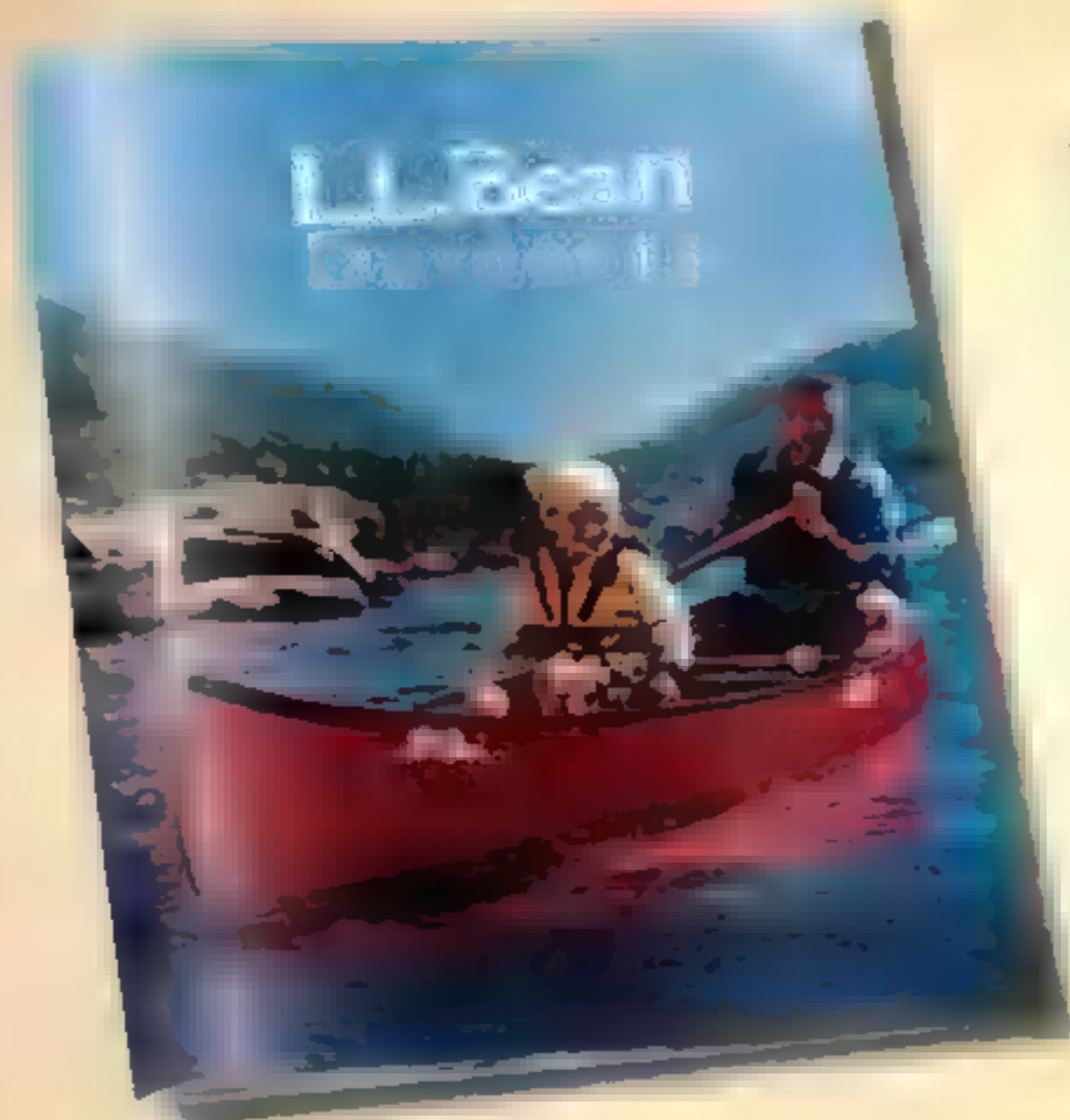
As a high school student in India, I was inspired by your 1982 Silicon Valley article to come and try my fortune here. The new article misses the point; it does not tally the achievements of the past 20 years but focuses on the local social impact. In 1982 personal computers were still new, there was no Internet, and the global technology boom was yet to

happen. The wealth created and the lives influenced since then are astounding. The revolution is no longer limited to Silicon Valley; it literally spans the globe.

MALAY JALUNDHWALA  
*San Francisco, California*

I find it ironic that in trying to make the world interconnected, the people of Silicon Valley are so isolated in their own time and interests. Reading the article, I felt as if I could be reading a modern version of Gibbon's *Decline and Fall*. I am frightened to think that the Silicon Valley lifestyle reflects that we've lost the sense of purpose in Kennedy's "Ask not what your country can do for you."

RODGER C. LEWIS  
*Greenville, North Carolina*



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Your Silicon Valley story barely scratched the surface of the place my family has called home for four generations. This valley is more than an "extended suburb of flat monotony." There are thriving downtowns and historic districts, scenic parks, open-space preserves, vibrant ethnic neighborhoods, and great cultural institutions. We have a proud heritage that reaches far beyond the founding of Hewlett-Packard.

NICK PERRY  
Mountain View, California

I grew up on the border of Atherton, then an affluent, white-collar town but really just filled with spacious ranch homes and a lot of regular folks. Fast forward to the 1990s, and it has been turned into a town of

opulent homes. People have to have enough space to house thousands of bottles of wine, six cars, and seasonal closets to survive in our monoclimate. The ranches have been demolished at a feverish rate. People can buy their way out of civic and public engagement here. We are victims of our own success.

CHARMAINE PICONE McCRYSTAL  
Redwood City, California

### Geographica

As I look at the toys made by the children in Indonesia, Africa, and South America, I am sad because my three grandchildren will probably never revel in the experience of creating "something from nothing." They have everything provided for them. The children from those

developing countries probably think they are deprived, but they are the fortunate ones. They are given the opportunity to use their rich imaginations.

LANE SMITH CORBIN  
Traverse City, Michigan

### The Future Is Calling

Your map on pages 80-81 gives a good representation of world Internet use. However, I think it misses the geographically important fact that Scandinavia, Iceland, and Canada have a significantly higher percentage of Internet users than the United States.

JOHN TERPSTRA  
Garson, Ontario

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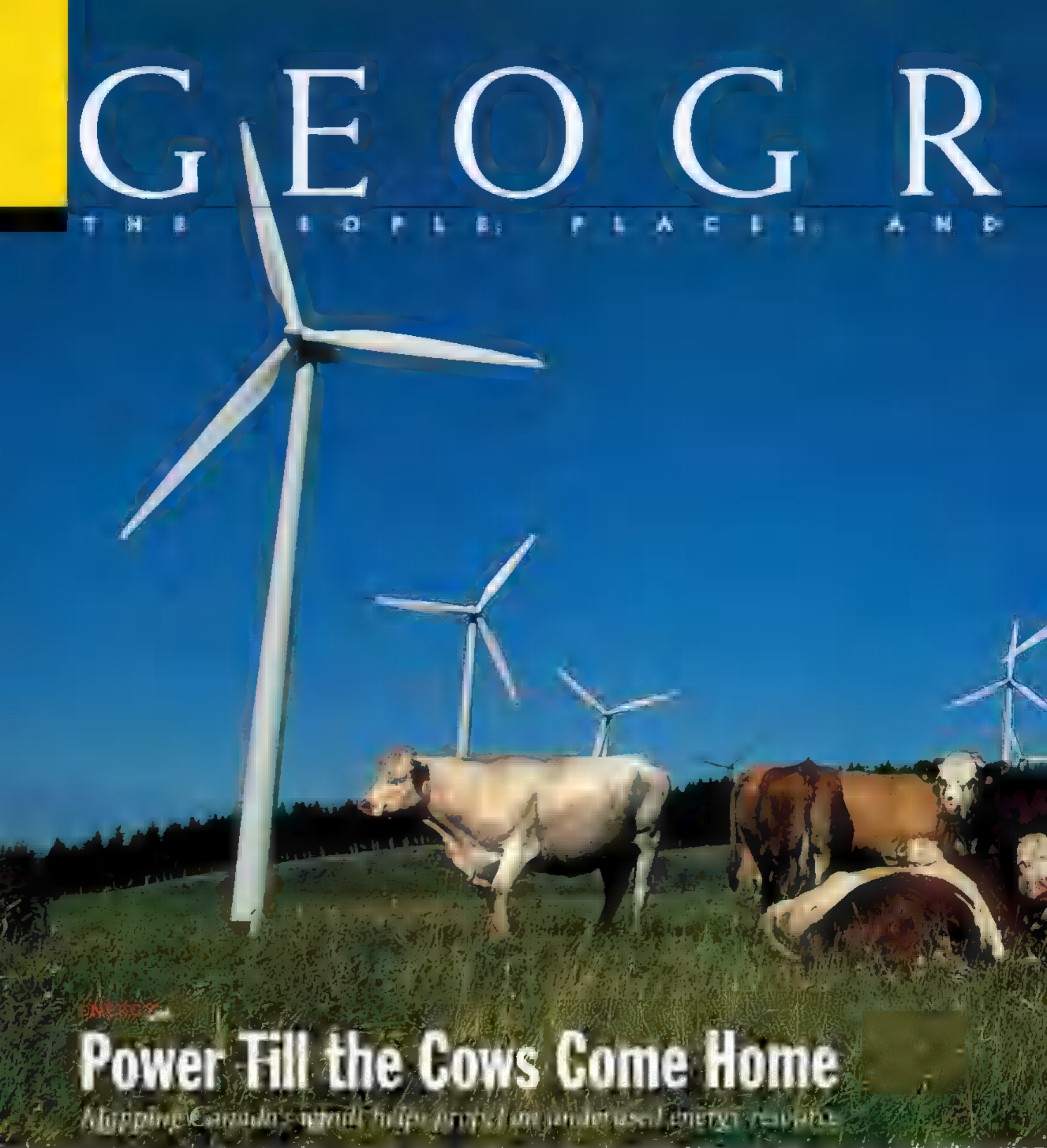
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# G E O G R

T H E T O P L E P L A C E S A N D



## Power Till the Cows Come Home

Mapping Canada's wind helps predict an industrial energy future.

**S**trong winds of change are blowing through the energy industry. Wind has become the world's fastest growing power source, increasing some 30 percent annually since 1996. Global wind-generation capacity now exceeds 23,000 megawatts, enough electricity to power more than 10 million households in industrialized countries.

To harness the strongest and most consistent winds that sweep over Canada, atmospheric

scientists Robert Benoit and Wei Yu of Environment Canada, a government agency, have created a wind-energy map of Canada and the United States. "We can help pinpoint a windy hilltop or valley to guide the placement of turbines," says Benoit.

On Canada's largest wind farm, Le Nordais on the Gaspé Peninsula (above), 133 turbines catch powerful winds from the Gulf of St. Lawrence. "Canadians are proud of these nonpolluting

machines," says Benoit. Improvements in turbine technology have also made wind energy cheaper. Worldwide, the cost per kilowatt-hour has dropped by 50 percent over the past decade.

The map shows other windy zones, in southern Saskatchewan and Manitoba and around the Great Lakes and Hudson Bay. In the U.S., light blue and green denote winds in the Great Plains.

"We have a long way to go to reach Canada's wind-energy

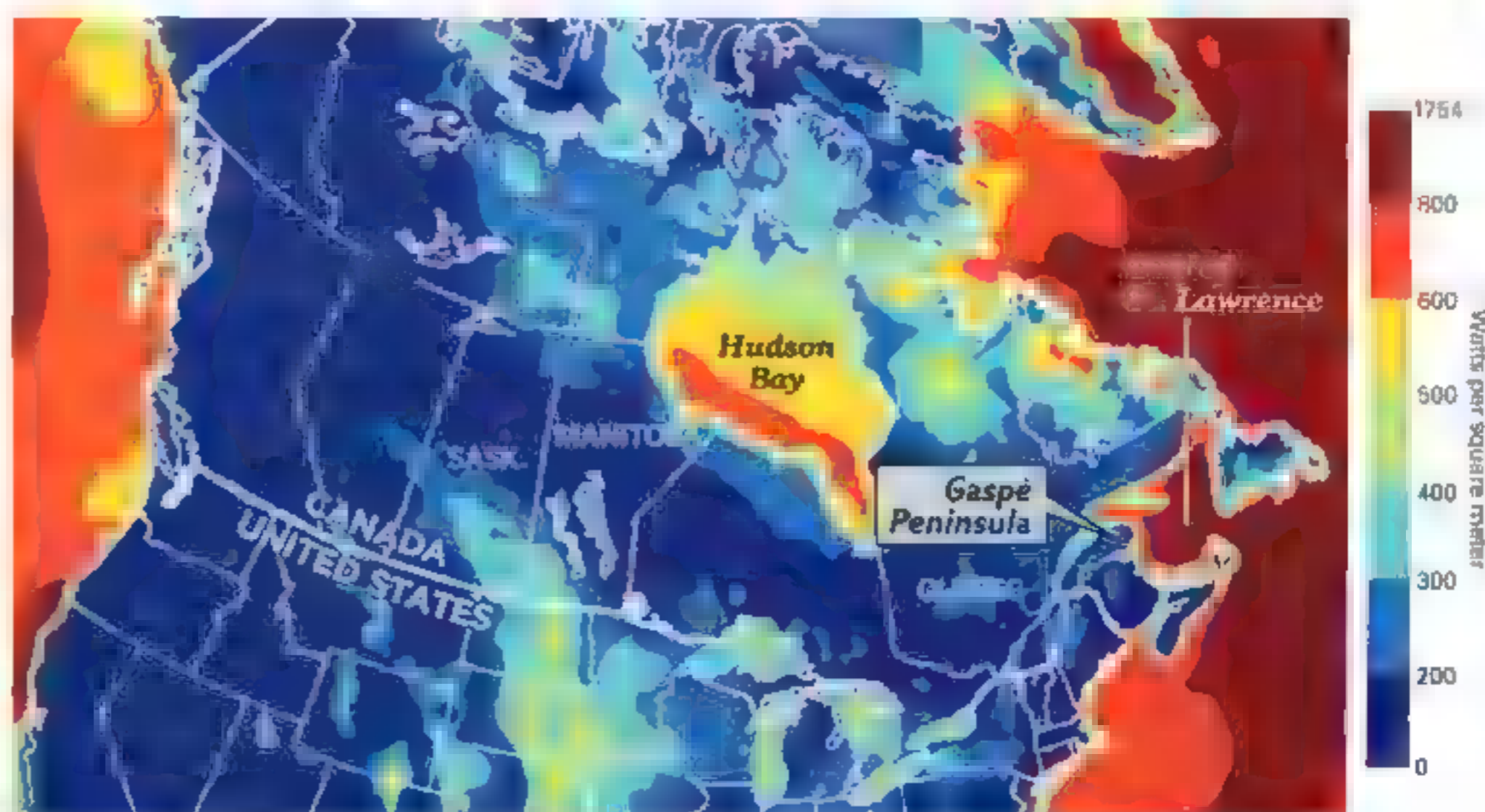


# APHICA

CREATURES OF OUR UNIVERSE



potential,” Benoit adds. Canada’s current capacity is 200 megawatts. Germany, with 8,750 megawatts, leads the world in wind development, followed by the U.S. (4,300 megawatts), Spain (3,300), and Denmark (2,500). To boost production, the Canadian government plans by 2005 to buy 20 percent of the electricity for its facilities from renewable sources. Most of this power is expected to come from wind.



WINTER (TOP); R. BENOIT AND W. YU, METEOROLOGICAL SERVICE, ENVIRONMENT (MAP)



## CARTOGRAPHY

## Directing Their Prayers

*New map helps Muslims know which way to turn*



NG MAPS  
SOURCE: AHMAD S. MASSASATI, UAE UNIVERSITY

When Muslims pray, they are to face the shortest distance to the Kaaba shrine in Mecca, Saudi Arabia. So Muslims in, say, Detroit should face southeast, right? Wrong. The shortest distance between the two points (shown as a straight line on the small globe) is actually northeast, taking into account the curvature of the Earth. To help orient the faithful, Ahmad S. Massasati, a geographer at the United Arab Emirates University, devised a map (left). Since Muslims encircle the Kaaba to pray, the map amplifies these circles around the globe until they reach Mecca's antipode—its opposite point on the other side of the Earth. The proper praying direction lies perpendicular to these circles.



TAYLOR JOHNSON/ALSTIC/ISTOCKPHOTO.COM

## CONSERVATION

## Demystifying Bats

A boy named Hector likes Marcelo the bat. The Mexican mascot was created by the Program for the Conservation of Migratory Bats. It promotes the value of bats in Mexico, where fear and superstition about

the night fliers is pervasive.

"Millions of bats have been burned, poisoned, or dynamited in Mexican caves," says Merlin Tuttle, president of Bat Conservation International, a program sponsor. About 100 million Mexican free-tailed bats that winter in Mexican caves spend the warm season eating billions of insect pests in Texas (page 114).

## ALMANAC

## April

When the ice begins to fracture on the Stikine River Delta in southeastern Alaska, bald eagles arrive en masse. A species of smelt, called hooligan by local Alaskans, spawns in the river, and as many as 1,600 eagles gang up along the tidal flats to feast on the small fish.



BY JODI WALES

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Are you or someone you care for experiencing any of the following?

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**Repeating questions?**

**Having trouble  
finding words?**



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ARICEPT® is well tolerated but may not be for everyone. Some people may experience nausea, diarrhea, insomnia, vomiting, muscle cramps, fatigue or loss of appetite. In studies, these side effects were usually mild and temporary. Some people taking ARICEPT® may experience fainting. People at risk for ulcers should tell their doctors because their condition may get worse.

Only a doctor can say if memory problems are due to Alzheimer's disease. And the sooner you know, the sooner ARICEPT® may help. So speak to a doctor today and ask about ARICEPT®, the #1 prescribed medicine for Alzheimer's disease.

SEE A DOCTOR AND ASK ABOUT

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**ARICEPT**® (donepezil HCl) 5-MG AND 10-MG TABLETS  
 MEDICINE TO REMEMBER™

**ARICEPT® (Donepezil Hydrochloride Tablets)**

**Brief Summary**—see package insert for full prescribing information. **INDICATIONS AND USAGE** ARICEPT® is indicated for the treatment of mild to moderate dementia of the Alzheimer's type. **CONTRAINDICATIONS** ARICEPT® is contraindicated in patients with known hypersensitivity to donepezil hydrochloride or to piperidine derivatives. **WARNINGS Anesthesia:** ARICEPT®, as a cholinesterase inhibitor, is likely to exaggerate succinylcholine-type muscle relaxation during anesthesia. **Cardiovascular Conditions:** Because of their pharmacological action, cholinesterase inhibitors may have vagotonic effects on the sinoatrial and atrioventricular nodes. This effect may manifest as bradycardia or heart block in patients both with and without known underlying cardiac conduction abnormalities. Syncope has been reported in association with the use of ARICEPT®. **Gastrointestinal Conditions:** Through their primary action, cholinesterase inhibitors may be expected to increase gastric acid secretion due to increased cholinergic activity. Therefore, patients should be monitored closely for symptoms of active or occult gastrointestinal bleeding, especially those at increased risk for developing ulcers, e.g., those with a history of ulcer disease or those receiving concurrent nonsteroidal anti-inflammatory drugs (NSAIDs). Clinical studies of ARICEPT® have shown an increase, relative to placebo, in the incidence of either peptic ulcer disease or gastrointestinal bleeding. ARICEPT®, as a predictable consequence of its pharmacological properties, has been shown to produce diarrhea, nausea and vomiting. These effects, when they occur, appear more frequently with the 10 mg/day dose than with the 5 mg/day dose. In most cases, these effects have been mild and transient, sometimes lasting one to two weeks, and have resolved during continued use of ARICEPT®. **Genitourinary:** Although not observed in clinical trials of ARICEPT®, cholinomimetics may cause urinary obstruction. **Neurological Conditions:** Seizures: Cholinomimetics are believed to have some potential to cause generalized convulsions. However, seizure activity also may be a manifestation of Alzheimer's Disease. **Pulmonary Conditions:** Because of their cholinomimetic actions, cholinesterase inhibitors should be prescribed with caution to patients with a history of asthma or obstructive pulmonary disease. **PRECAUTIONS Drug-Drug Interactions Drugs Highly Bound to Plasma Proteins:** Drug displacement studies have been performed *in vitro* between this highly bound drug (96%) and other drugs such as furosemide, digoxin, and warfarin. ARICEPT® at concentrations of 0.3-10 µg/mL did not affect the binding of furosemide (5 µg/mL), digoxin (2 ng/mL), and warfarin (3 µg/mL) to human albumin. Similarly, the binding of ARICEPT® to human albumin was not affected by furosemide, digoxin, and warfarin. **Effect of ARICEPT® on the Metabolism of Other Drugs:** No *in vivo* clinical trials have investigated the effect of ARICEPT® on the clearance of drugs metabolized by CYP 3A4 (e.g. cisapride, terfenadine) or by CYP 2D6 (e.g. imipramine). However, *in vitro* studies show a low rate of binding to these enzymes (mean K<sub>i</sub> about 50-130 µM) that, given the therapeutic plasma concentrations of donepezil (184 nM), indicates little likelihood of interference. Whether ARICEPT® has any potential for enzyme induction is not known. **Effect of Other Drugs on the Metabolism of ARICEPT®:** Ketoconazole, quinidine, inhibitors of CYP450, 3A4 and 2D6, respectively, inhibit donepezil metabolism *in vitro*. Whether there is a clinical effect of these inhibitors is not known. Inducers of CYP 2D6 and CYP 3A4 (e.g., phenytoin, carbamazepine, dexamethasone, ritampin, and phenobarbital) could increase the rate of elimination of ARICEPT®. **Use with Anticholinergics:** Because of their mechanism of action, cholinesterase inhibitors have the potential to interfere with the activity of anticholinergic medications. **Use with Cholinomimetics and Other Cholinesterase Inhibitors:** A synergistic effect may be expected when cholinesterase inhibitors are given concurrently with succinylcholine, similar neuromuscular blocking agents or cholinergic agonists such as bethanechol. **Carcinogenesis, Mutagenesis, Impairment of Fertility** Carcinogenicity studies of donepezil have not been completed. Donepezil was not mutagenic in the Ames reverse mutation assay in bacteria. In the chromosome aberration test in Chinese hamster lung (CHL) cells, donepezil at concentrations up to 100 µg/mL was not clastogenic. Donepezil was not clastogenic in the *in vivo* mouse micronucleus test. Donepezil had no effect on fertility in rats at doses up to 10 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m<sup>2</sup> basis). **Pregnancy Pregnancy Category C:** Teratology studies conducted in pregnant rats at doses up to 16 mg/kg/day (approximately 13 times the maximum recommended human dose on a mg/m<sup>2</sup> basis) and in pregnant rabbits at doses up to 10 mg/kg/day (approximately 16 times the maximum recommended human dose on a mg/m<sup>2</sup> basis) did not disclose any evidence for a teratogenic potential of donepezil. However, in a study in which pregnant rats were treated up to 16 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m<sup>2</sup> basis) from day 17 gestation through day 20 postpartum, there was a slight increase in still births and a slight decrease in pup survival through day 4 postpartum at this dose; the next lower dose tested was 3 mg/kg/day. There are no adequate or well-controlled studies in pregnant women. ARICEPT® should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Nursing Mothers:** It is not known whether donepezil is excreted in human breast milk. ARICEPT® has no indication for use in nursing mothers. **Pediatric Use:** There are no adequate and well-controlled trials to document the safety and efficacy of ARICEPT® in any illness occurring in children. **ADVERSE REACTIONS Adverse Events Leading to Discontinuation** The rates of discontinuation from controlled clinical trials of ARICEPT® are shown in Table 1.

**Table 1. Most Frequent Adverse Events Leading to Withdrawal from Controlled Clinical Trials by Dose Group**

Dose Group	Placebo	5 mg/day ARICEPT®	10 mg/day ARICEPT®
<b>Patients Randomized</b>	355	350	315
<b>Event/%Discontinuing</b>			
Nausea	1%	1%	3%
Diarrhea	0%	<1%	3%
Vomiting	<1%	<1%	2%

most common adverse events leading to discontinuation defined as those occurring in at least 2% of patients and at twice the incidence seen in placebo patients, are shown in Table 1.

**Most Frequent Adverse Clinical Events Seen in Association with the Use of ARICEPT®** The most common adverse events, defined as those occurring at a frequency of at least 5% in patients receiving 5 mg/day or 10 mg/day, are largely predicted by ARICEPT®'s cholinomimetic activity. These include nausea, diarrhea, insomnia, vomiting, muscle cramp, fatigue and anorexia. These adverse events were often of mild intensity and transient, resolving during continued ARICEPT® treatment without the need for dose modification. There is evidence to suggest that the frequency of these common adverse events may be affected by the rate of titration. An open-label study was conducted with 269 patients who received placebo in the 15- and 30-week studies. These patients were titrated to a dose of 10 mg/day over a 6-week period. The rates of common adverse events were lower than those seen in patients titrated to 10 mg/day over one week in the controlled clinical trials and were comparable to those seen in patients on 5 mg/day. Table 2 for a comparison of the most common adverse events following one and six week titration regimens.

**Table 2. Comparison of Rates of Adverse Events in Patients Titrated to 10 mg/day Over 1 and 6 Weeks**

Adverse Event	No titration		One-week titration		Six-week titration	
	Placebo (n=315)	5 mg/day (n=311)	10 mg/day (n=315)	10 mg/day (n=269)	10 mg/day (n=269)	10 mg/day (n=269)
Nausea	6%	5%	19%	6%	6%	6%
Diarrhea	5%	6%	15%	9%	9%	9%
Insomnia	6%	6%	14%	6%	6%	6%
Fatigue	3%	4%	8%	9%	9%	9%
Vomiting	3%	3%	8%	5%	5%	5%
Muscle cramps	2%	6%	8%	3%	3%	3%
Anorexia	2%	3%	7%	3%	3%	3%

Adverse Events Reported in Controlled Trials The events cited reflect experience gained in controlled clinical trials in a highly selected patient population. In actual clinical practice, these frequency estimates may not apply as the conditions of use, reporting behavior and the kinds of patients treated may differ. Table 3 lists

treatment emergent signs and symptoms that were reported in at least 2% of patients in placebo-controlled trials who received ARICEPT® and for which the rate of occurrence was greater for ARICEPT® assigned than placebo assigned patients in general, adverse events occurred more frequently in female patients and with advancing age.

**Table 3. Adverse Events Reported in Controlled Clinical Trials in at Least 2% of Patients Receiving ARICEPT® (donepezil HCl) and at a Higher Frequency than Placebo-treated Patients**

Body System/Adverse Event	Placebo (n=355)	ARICEPT® (n=747)
<b>Percent of Patients with any Adverse Event</b>	<b>72</b>	<b>74</b>
<b>Body as a Whole</b>		
Headache	8	10
Pain, various locations	8	9
Accident	6	7
Fatigue	3	5
<b>Cardiovascular System</b>		
Syncope	1	2
<b>Digestive System</b>		
Nausea	6	11
Diarrhea	0	10
Vomiting	0	0
Anorexia	2	4
<b>Hemic and Lymphatic System</b>		
Echymosis	3	4
<b>Metabolic and Nutritional Systems</b>		
Weight decrease	1	3
<b>Musculoskeletal System</b>		
Muscle Cramps	2	0
Arthritis	1	2
<b>Nervous System</b>		
Insomnia	6	9
Dizziness	6	0
Depression	<1	3
Abnormal involuntary movements	0	3
Somnolence	<1	2
<b>Urogenital System</b>		
Frequent Urination	1	2

**Other Adverse Events Observed During Clinical Trials** ARICEPT® has been administered to over 1700 individuals during clinical trials worldwide. Approximately 1000 of these patients have been treated for at least 3 months and more than 1000 patients have been treated for at least 6 months. Controlled and uncontrolled trials in the United States included approximately 900 patients. In regards to the highest dose of 10 mg/day, this population includes 650 patients treated for 3 months, 475 patients treated for 6 months and 116 patients treated for over 1 year. The range of patient exposure is from 1 to 1214 days. Treatment emergent signs and symptoms that occurred during 3 controlled clinical trials and 10 open-label trials in the United States were listed as adverse events by the clinical investigators using terminology of their own choosing. To provide an overall estimate of the proportion of individuals having similar types of events, the events were grouped into a smaller number of standardized categories using a modified COSTART dictionary and event frequencies were calculated across all studies. These categories are used in the listing below. The frequencies represent the proportion of patients from all clinical trials who experienced that event while receiving ARICEPT®. All adverse events occurring in at least 2% of patients are included, except for those already listed in Tables 2 or 3. COSTART terms too general to be informative or events less likely to be drug caused, are not classified by body system and listed using the following definitions: **frequent adverse events**—those occurring in at least 1/100 patients; **infrequent adverse events**—those occurring in 1/100 to 1/1000 patients. These adverse events are not necessarily related to ARICEPT® treatment and in most cases were observed at a similar frequency in placebo-treated patients in the controlled studies. No important additional adverse events were seen in studies conducted outside the United States. **Body as a Whole:** Frequent: influenza, chest pain, toothache. Infrequent: fever, edema face, periorbital edema, hema nasal, abscess, cellulitis, chills, generalized coldness, malaise, lightheadedness. **Cardiovascular System:** Frequent: hypertension, vasodilation, atrial fibrillation, hot flashes, hypotension. Infrequent: angina pectoris, postural hypotension, myocardial infarction, AV block (first degree), congestive heart failure, arteritis, bradycardia, peripheral vascular disease, supraventricular tachycardia, deep vein thrombosis. **Digestive System:** Frequent: fecal incontinence, gastrointestinal bleeding, bloating, epigastric pain. Infrequent: eructation, gingivitis, increased appetite, flatulence, periodontal abscess, cholelithiasis, diverticulitis, drooling, dry mouth, fever sore, gastritis, ileal colitis, tongue edema, epigastric distress, gastroenteritis, increased transaminases, hemorrhoids, ileus, increased thirst, jaundice, melena, polydipsia, duodenal ulcer, stomach ulcer. **Endocrine System:** Infrequent: diabetes mellitus, goiter. **Hemic and Lymphatic System:** Infrequent: anemia, thrombocytopenia, thrombocytopenia, eosinophilia, erythrocytopenia. **Metabolic and Nutritional Disorders:** Frequent: dehydration. Infrequent: gout, hypokalemia, increased creatine kinase, hyperglycemia, weight increase, increased lactate dehydrogenase. **Musculoskeletal System:** Frequent: bone fracture. Infrequent: weakness, muscle fasciculation. **Nervous System:** Frequent: delusions, tremor, irritability, paresthesia, aggression, vertigo, ataxia, increased libido, restlessness, abnormal crying, nervousness, aphasia. Infrequent: cerebrovascular accident, intracranial hemorrhage, transient ischemic attack, emotional lability, neuralgia, coldness (localized), muscle spasm, dysphoria, gait abnormality, hypotonia, hypokinesia, neurodermatitis, numbness (localized), paranoia, dysarthria, dysphasia, hostility, decreased libido, melancholia, emotional withdrawal, nystagmus, pacing. **Respiratory System:** Frequent: dyspnea, pharyngitis, bronchitis. Infrequent: epistaxis, post nasal drip, pneumonia, hyperventilation, pulmonary congestion, wheezing, hypoxia, pharyngitis, pleurisy, pulmonary collapse, sleep apnea, snoring. **Skin and Appendages:** Frequent: pruritus, diaphoresis, urticaria. Infrequent: dermatitis, erythema, skin discoloration, hyperkeratosis, seborrhea, fungal dermatitis, herpes zoster, hirsutism, skin striae, night sweats, skin ulcer. **Special Senses:** Frequent: cataract, eye irritation, blurred vision. Infrequent: dry eyes, glaucoma, earache, tinnitus, blepharitis, decreased hearing, conjunctival hemorrhage, otitis externa, otitis media, bad taste, conjunctival hemorrhage, ear buzzing, motion sickness, spots before eyes. **Urogenital System:** Frequent: urinary incontinence, nocturia. Infrequent: dysuria, hematuria, urinary urgency, metrorrhagia, cystitis, prostatic hypertrophy, pyelonephritis, inability to empty bladder, breast fibroadenosis, fibrocystic breast, mastitis, pyuria, renal failure, vaginitis. **Postintroduction Reports** Voluntary reports of adverse events temporally associated with ARICEPT® that have been received since market introduction that are not listed above, and that there is inadequate data to determine the causal relationship with the drug include the following: abdominal pain, agitation, cholecystitis, confusion, convulsions, hallucinations, heart block (all types), hemolytic anemia, hepatitis, hypocalcemia, neuroleptic malignant syndrome, pancreatitis, and rash. **OVERDOSAGE Because strategies for the management of overdose are continually evolving, it is advisable to contact a Poison Control Center to determine the latest recommendations for the management of an overdose of any drug.** As in any overdose, general supportive measures should be utilized. Overdosage with cholinesterase inhibitors can result in a cholinergic crisis characterized by nausea, vomiting, salivation, sweating, bradycardia, hypotension, respiratory depression, collapse and convulsions. Increasing muscle weakness is a possibility and may result in respiratory muscles are involved. Tertiary anticholinergics such as atropine may be used as an antidote for ARICEPT® overdosage. Intravenous atropine sulfate titrated to effect is recommended; an initial dose of 1.0 to 2.0 mg IV with subsequent doses based on clinical response. Atypical responses in blood pressure and heart rate have been reported with other cholinomimetics when co-administered with quaternary anticholinergics such as glycopyrrolate. It is not known whether ARICEPT® metabolites be removed by dialysis (hemodialysis, peritoneal dialysis, hemofiltration). Dose-related signs of toxicity in animals included reduced spontaneous movement, prone position, staggering gait, lacrimation, tonic convulsions, depressed respiration, salivation, miosis, tremors, fasciculation and lower body surface temperature.

200176 Revised December 2000





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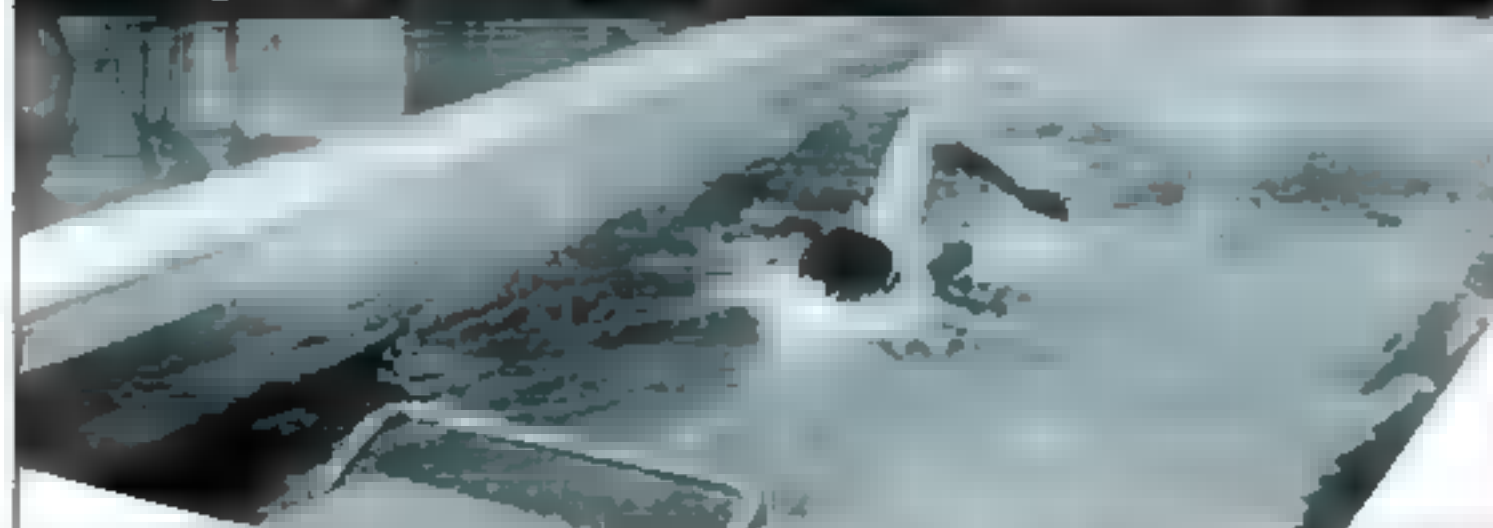
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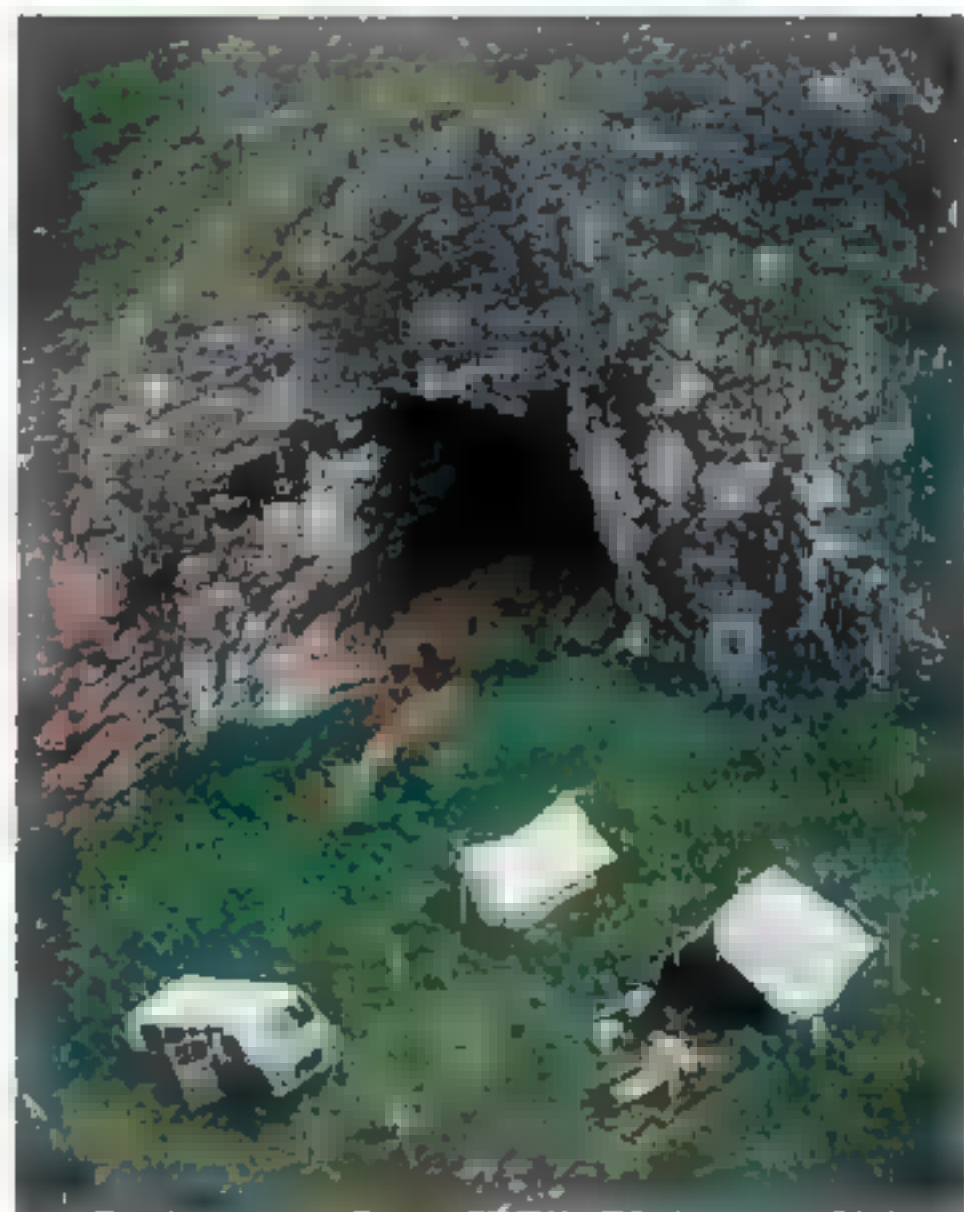
■ NGS RESEARCH GRANT

## The Hyena's Last Laugh

*Prehistoric bones' mysterious markings explained*

Scientists have known for decades about human and animal bones—some as old as 40,000 years—in limestone caves of Ukraine and Siberia, including the cave at Dvagliaska (right). But they have not known what made tooth marks in the bones. Though some theories

attributed the gouges to Pleistocene and Holocene cannibalism, Society grantee Christy G. Turner II has determined that the damage was done by carnivores, including now extinct hyenas. Hyena teeth found in the caves and markings on the bones (above) match closely.



BOTH ■ CHRISTY G. TURNER II



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NATURE

## Peccaries vs. People

Arizonans, especially newcomers, are complaining of 40-pound intruders with fearsome teeth that tear up their gardens. Collared peccaries, or javelinas, have spread north from Mexico as southwestern grasslands shrink. Where cattle mow the grasses down, dense brush—favored by the wild pigs—takes over. Urban amenities like shelter, water, and tasty garden bulbs attract them, and the peccary peccadilloes begin.





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**GET OFF**

(Okay, it may seem like I hate my parents, but I'm really demonstrating what a therapist would call "asserting my identity," so I can grow up to be a well-adjusted individual. Sure, I say I want freedom, but without parental supervision, I'm much more likely to smoke pot and stuff. I hope my parents don't try to act like my friends. What I really need is parents.)

**MY BACK.**

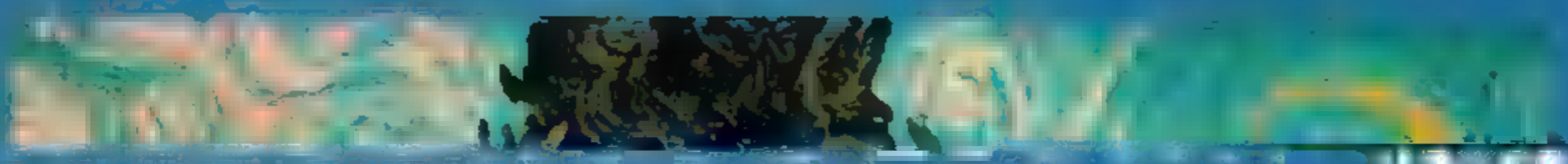
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# Behind the SCENES

## Visit to a New World

**P**loddling through Gabon near the end of the Mega-transect (GEOGRAPHIC, October 2000, March and August 2001), photographer Michael "Nick" Nichols became friendly with Sophiano Etouck, a Bantu member of the team. Somewhere in the jungle



TOM WOLFF; DAVID BELLOCK (TOP)

Sophiano told Nick he wanted to visit America. "Are you serious?" Nick asked. Sophiano insisted he was. And so, months later, Sophiano flew to Washington, D.C., for a three-month stay with Nick in his Charlottesville, Virginia, home (left).

The pair spent most of the visit working on Nick's farm, but they also took time for Sophiano to absorb other aspects of the U.S. He saw Charlottesville's Fourth of July celebrations, visited Washington's monuments and museums, even went



skydiving (above)—with an instructor. "Nothing was the way I had expected, except for the feeling of prosperity and well-being," he says. The highlight of his visit: seeing the White House.

Sophiano is now back in Gabon, working to preserve one of the pristine forest tracts encountered during the Mega-transect. Nick, for his part, says, "I realize I've made a friend I'll care about for my whole life."

## Come On In!

*Inviting displays greet visitors to our home*

**T**his replica of a young Maya lord (right) from the facade of a 1,200-year-old structure at Copán in Honduras graces one of the large windows in our Washington, D.C., headquarters—part of a major remodeling and landscaping effort. Other windows feature artifacts and 3-D maps that highlight the Society's long-standing role in geographical research and



MARK THIESSEN, NGS

exploration. "The new displays are eye-catching and educational," says Susan Norton, director of Explorers Hall, our

in-house museum. "With the windows and the changing exhibits inside, we want to welcome, inform, and inspire."





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## Surf's Up Again

*Riding a wave of memory*

Sitting under a hair dryer in a Portland, Oregon, beauty parlor, Jean Brier Lusk (right) spotted a striking row of surfboards in the February 2001 *GEOGRAPHIC* (inset). "To my utter amazement, I recognized two of my best friends and myself in the photo," she says. "This picture was taken when I was 16, and all these years later, in the year of my 80th birthday, it was there before me."

As she remembers it, Richard H. Stewart, photographing tourists at Waikiki Beach for an article on Hawaii, approached her, fourth from the left, and her friends, Clarice Cross, far left, and Virginia "Ginger" Thomas,



PHIL SCHOFIELD



second from the left, to see if they were indeed visitors. "We

bridled indignantly," she recalls. "We'd all grown up in Hawaii." But Stewart noted that he had six surfboards and only three tourists, so the teens agreed to pose.

"I did some surfing, but I wasn't good," says Mrs. Lusk, a retired first-grade teacher and great-grandmother. "My brother was the good surfer in the family." She went to Northwestern University, then remained on the mainland when World War II broke out. "Pearl Harbor came along and changed our lives," she says.

## Historian Hits the Road

*Braddock's rough ride*

In 1755 the English general Edward Braddock set off from Wills Creek near what is now Cumberland, Maryland, to engage a French force at Fort Duquesne (later Pittsburgh). To get there, Braddock and his

troops had to build the first real road over the Appalachians. The mission failed—Braddock's force was defeated, and he was mortally wounded—but his route succeeded: It paved the way, so to speak, for the National Road (now U.S. 40) and Interstate 70.

Andrew Wahll, a former research cartographer in our map division, tells the story of the road's creation in *Braddock Road Chronicles, 1755*. Using diaries and army records, Andy documents Braddock's travails, spotlighting this section near Cumberland (left) where the general lost three wagons that got loose on the steep grade and crashed. Andy also has published a book on Maine's Popham Colony, a short-lived English settlement whose founding coincided with Jamestown's. Three more history projects are in the works.



VINCENT J. MUSI



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PENNY DE LOS SANTOS (ABOVE). POSTER DOG PROVIDED BY DOUG WASATC, UTAH

## Lessons of the Devils Postpile

*100,000-year-old lava makes education a blast*

**D**warfed by the basalt columns that lure visitors to Devils Postpile National Monument, Superintendent Deanna Dulen tells visiting schoolchildren how the formation was created in California's central Sierra Nevada range.

"The kids were totally into the geometry of the tops of the columns," Dulen says of the honeycombed surface. The postpile had its origins in a flow of lava about 100,000 years ago. As it cooled, the lava, some 400 feet deep, cracked into post-like

columns, whose top layers were sculpted away 20,000 years ago by Ice Age glaciers.

Last year the Society's Education Foundation awarded a \$24,000 grant to the California Geographic Alliance, which is jointly supported by the state's Department of Education and the Society. The alliance is working with local teachers and monument staff to develop information and activities to illustrate geography in action, focusing on volcanism, glaciation, and conservation. One project: creating an interpretive newsletter for park visitors.

The gift, part of the Society's Grosvenor Grant program, brought the total amount of money awarded by the foundation since it was launched in 1988 to nearly 45 million dollars.

## Healing Hearts

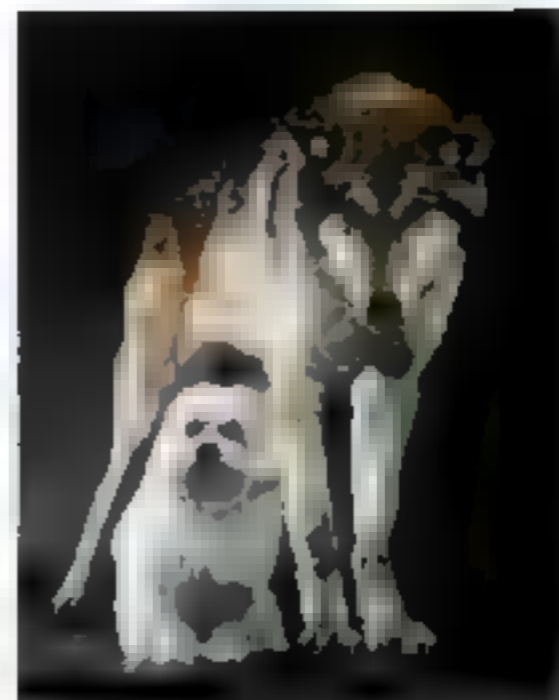
**W**riter Lewis M. Simons met Danzhou Duojie, a 16-year-old student monk, while traveling for "Tibetans" (pages 2-37). Danzhou was facing paralysis from scoliosis, his spine bent, his lungs crushed. Lew e-mailed a friend, Dr. Fred Epstein, a neurosurgeon at New York's Beth Israel Medical Center. Seven months later four doctors



IRA BLOCK

operated, at no cost, for 14 hours. A healthy Danzhou (above, with Lew) is now home, and Lew calls the result "amazing, a miracle."

### SPECIAL EDITION POSTER



A special-edition poster of Robert Clark's photograph, featured on our January 2002 cover, is available for \$39.95 plus \$6.95 for postage and handling (\$9.95 for international orders). Part of the proceeds will benefit Vital Ground, an organization working to protect grizzly bear and wolf habitat ([www.vitalground.org](http://www.vitalground.org)). Please add the appropriate sales tax for orders sent to CA, DC, FL, KY, MD, MI, PA, and Canada. We will produce only as many 24-by-30-inch prints as we receive orders for by May 31, 2002. Each will be hand-numbered and embossed with the Society seal. Shipping is scheduled for July 2002. To order, call toll free: 1-888-647-7301 (outside the U.S. and Canada call 1-515-362-3353).

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Washington, DC 20090-8199  
Internet: [nationalgeographic.com](http://nationalgeographic.com)







## nationalgeographic.com

## Sail the High Seas

Sailing *Amor Sports Too* sweeps through Sydney Harbour ahead of a school of other boats. Six months into the 32,000-mile, around-the-world Volvo Ocean Race, the competition has taken on what commentators and race veteran Andy Edwards calls a "time-space feel." There have been disqualifications, a successful mutiny, and ailing husband-and-wife skippers—and the race still has three months to go. Learn how the sailors avoid humpbacks as they boats cross whale migration routes. Keep up with the action at sea with Edwards's race dispatches, tour a virtual race, and take the helm of a sailing simulator at [nationalgeo.com/geo](http://nationalgeo.com/geo).

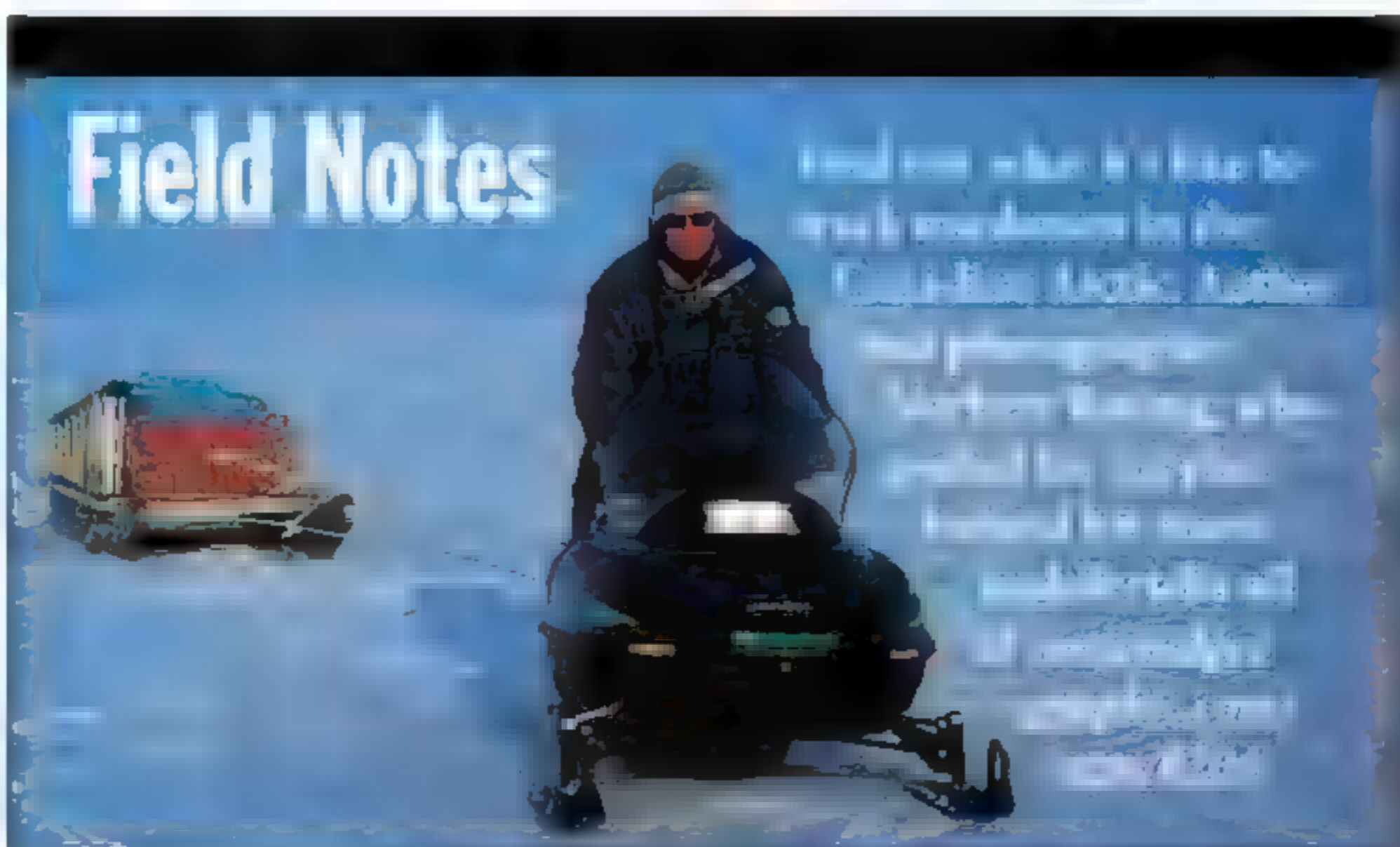


BORLENGHI

## Useful Tools

- **PHOTO OF THE DAY**  
Get your daily photo and e-mail it to a friend or download it as wallpaper at [nationalgeographic.com/photography/today](http://nationalgeographic.com/photography/today)
- **DESTINATION GUIDE**  
Find maps, tips, and more for travel at [nationalgeographic.com/destinations](http://nationalgeographic.com/destinations)

## Field Notes



ALLEN KITIGAN

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Photographed by Roland Sattre

# WILDLIFE AS CANON SEES IT

During daylight hours, the nocturnal riverine rabbit rests in forms on the shady side of dense riparian shrubs, its ample ears on the alert for predators. The female excavates a long subterranean nest chamber lined with grass and fur for her litter of one. This specialized nesting behavior confines the species to riverine habitat, where soils are suited to digging; however, 75 percent of natural riverine growth in the central Karoo has been lost to cultivation. Although the riverine rabbit is now protected, only micro populations

survive in a fragmented distribution along the dry riverbeds.

As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.



**Riverine Rabbit**  
(*Bunolagus monticularis*)

**Size:** Length, 33-47 cm

**Weight:** 1.4-1.8 kg

**Habitat:** Riverine scrub along seasonal rivers in the Karoo region of South Africa's Cape Province

**Surviving number:** Estimated at fewer than 600





WATCH "EXTINCT!" ON THE NATIONAL GEOGRAPHIC CHANNEL

# National Geographic TV



NATIONAL GEOGRAPHIC  
TELEVISION, PBS

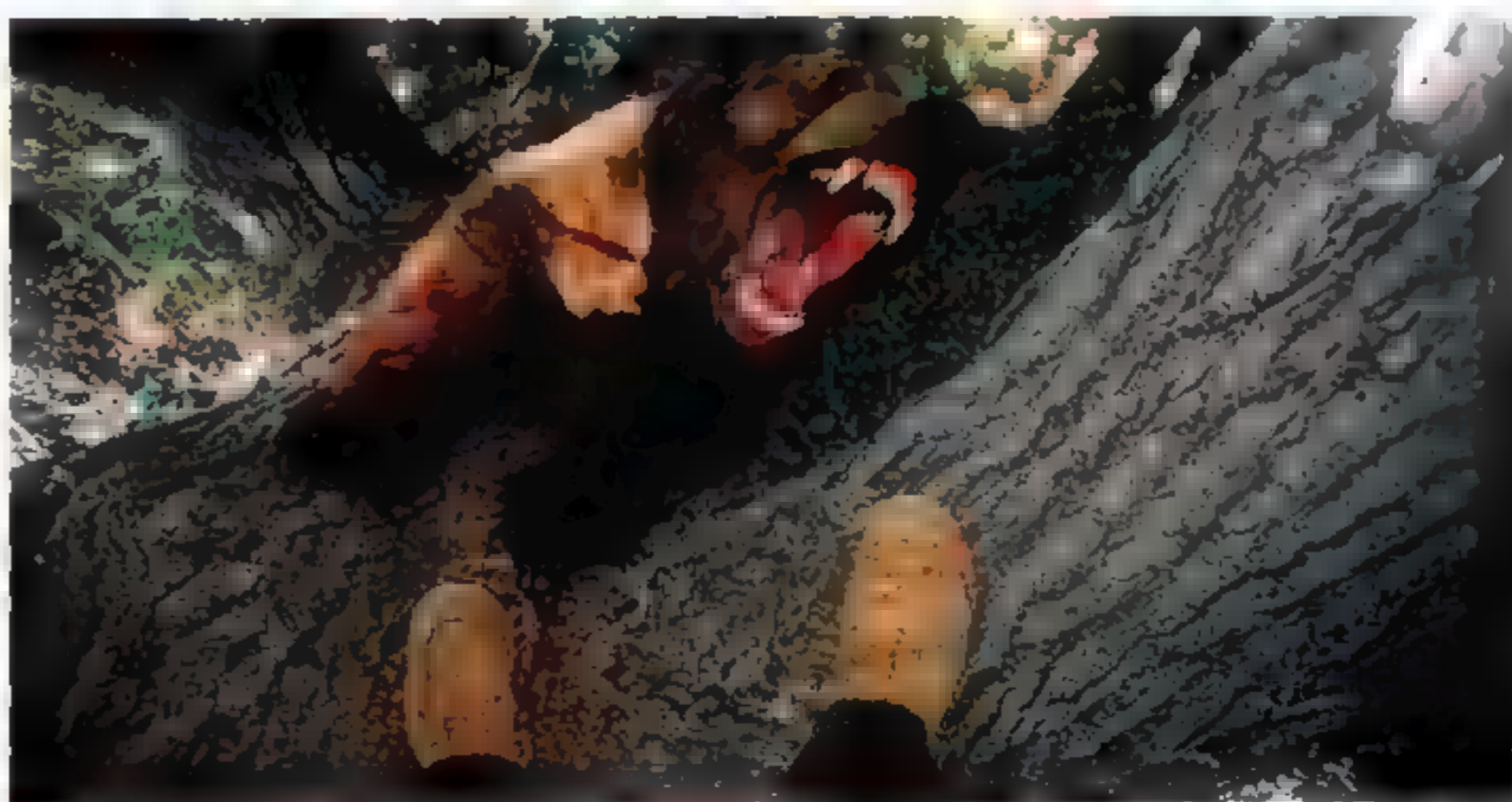
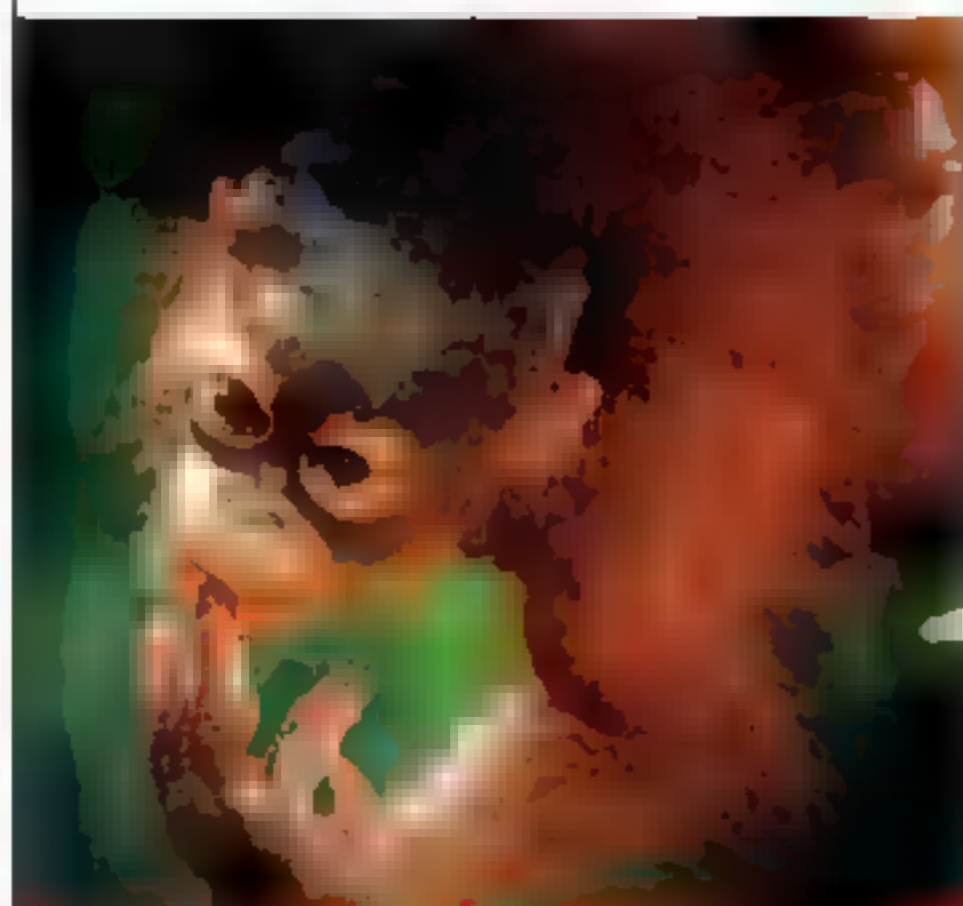
## Shape of Life

In the ancient oceans lived phytocentric creatures like jellyfish, whose basic body plan became the model for almost all animal species. *The Shape of Life*, a six-part series premiering this month, explains the foundations of the animal kingdom. Revisiting early life through innovative camera work and computer graphics, the series explains how species from the dawn of life developed the building blocks for movement, navigation, predation, and the transitional move from water to land.

NATIONAL GEOGRAPHIC  
CHANNEL

## Living Earth

Celebrate Earth Day with an evening of nature films. *The Disenchanted Forest* portrays efforts to rehabilitate orangutans in the wilds of Borneo.



BRIMBERG

THE IMAGE (LEFT), JOEL SARTORE

NATIONAL GEOGRAPHIC EXPLORER, MSNBC

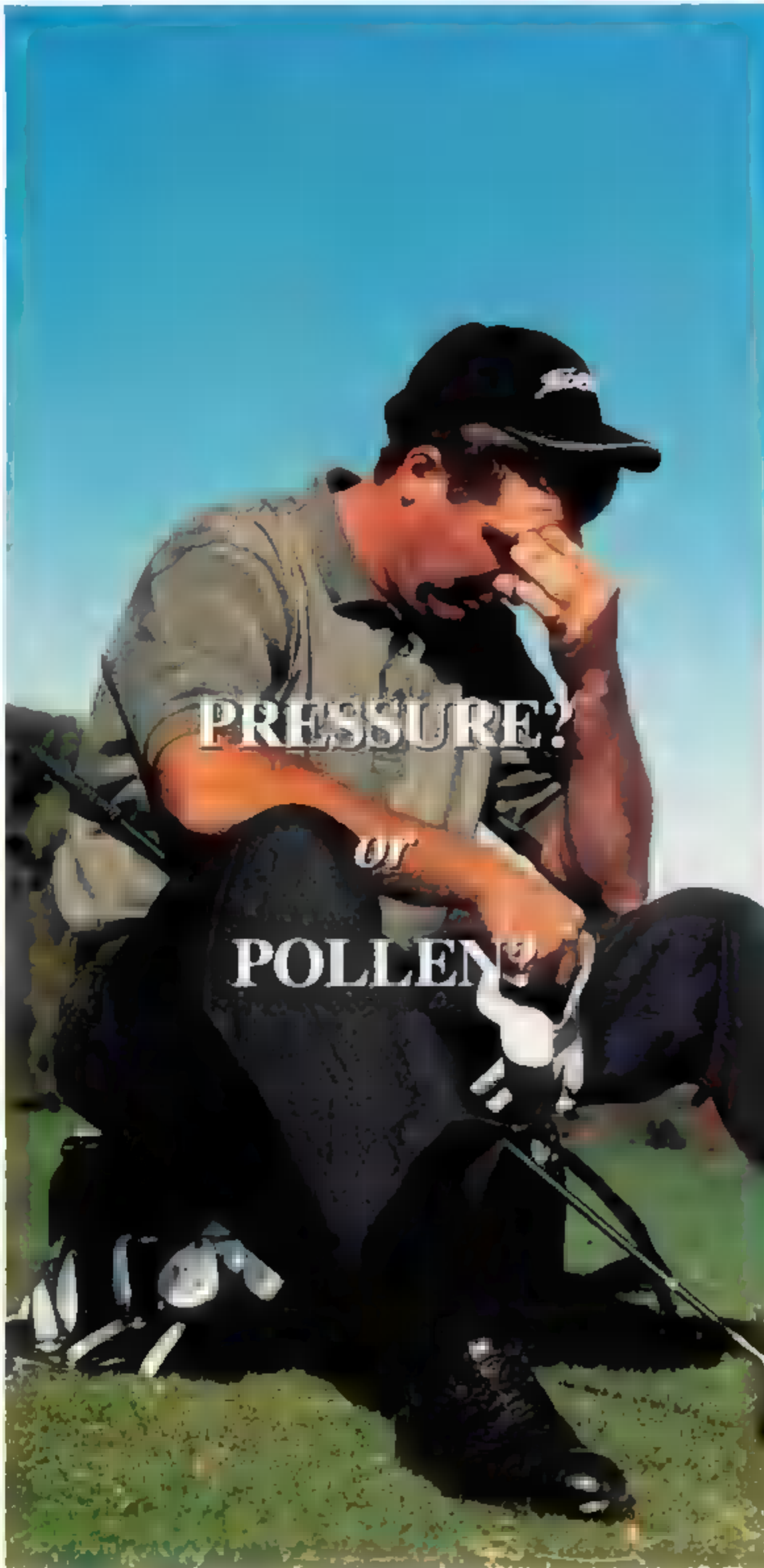
## Dangerous Neighbors

Defiant grizzly bears, marauding elephants, and agitated rattlesnakes come too close for comfort as humans and animals compete for space. *Wild Encounters* looks at how villagers and park officials cope with the frightening conflicts.

National Geographic Explorer, MSNBC, Sundays, 8 p.m. ET/5 p.m. PT. National Geographic Specials, PBS. See local listings. National Geographic Videos, Kids Videos, and DVDs Call 1-800-827-5162. National Geographic Channel Call your cable or satellite provider.

■ Programming information accurate ■ press time; consult local listings or our website at nationalgeographic.com.

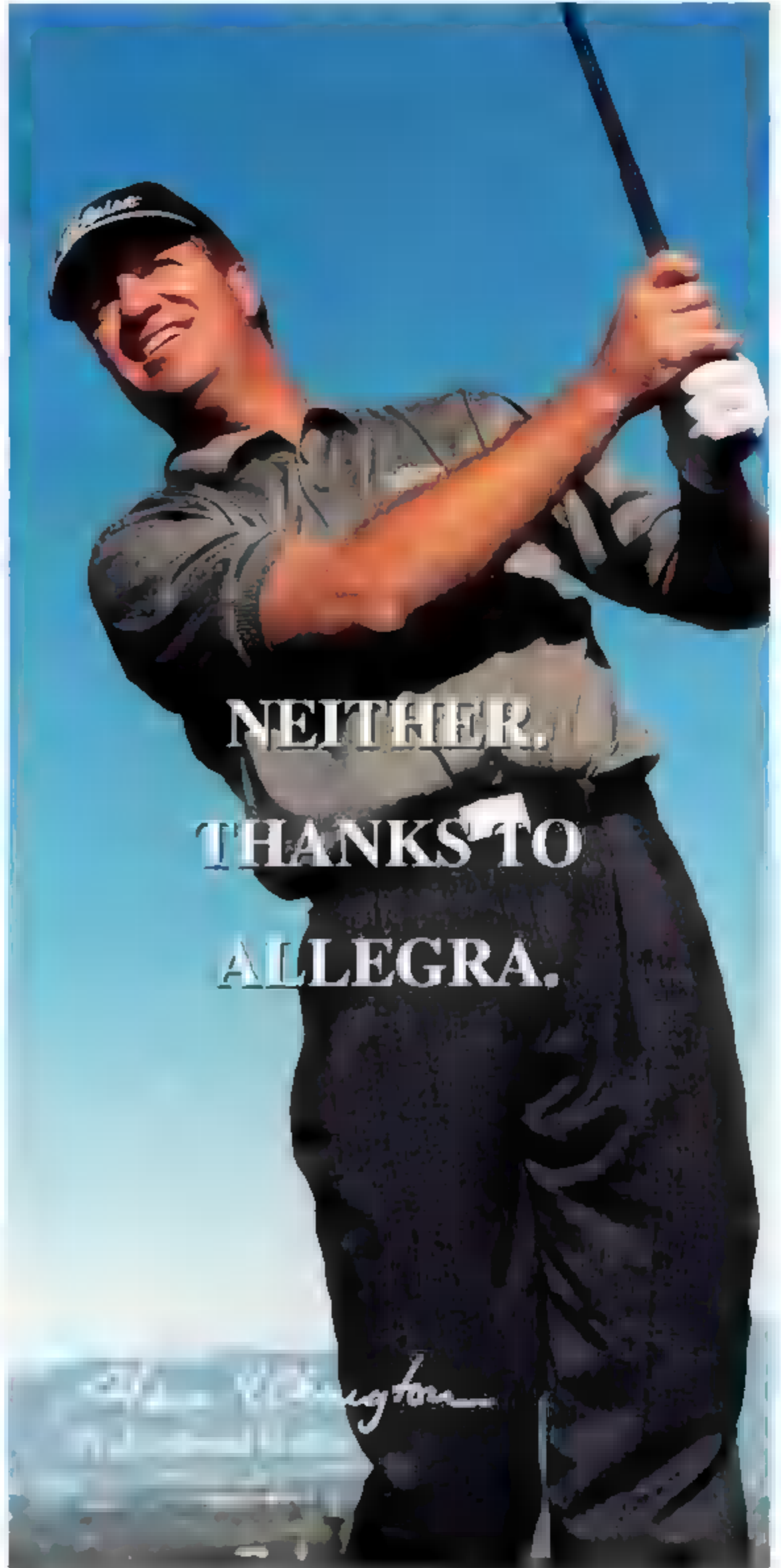




**PRESSURE?**

*or*

**POLLEN?**



**NEITHER.**

**THANKS TO**

**ALLEGRA.**

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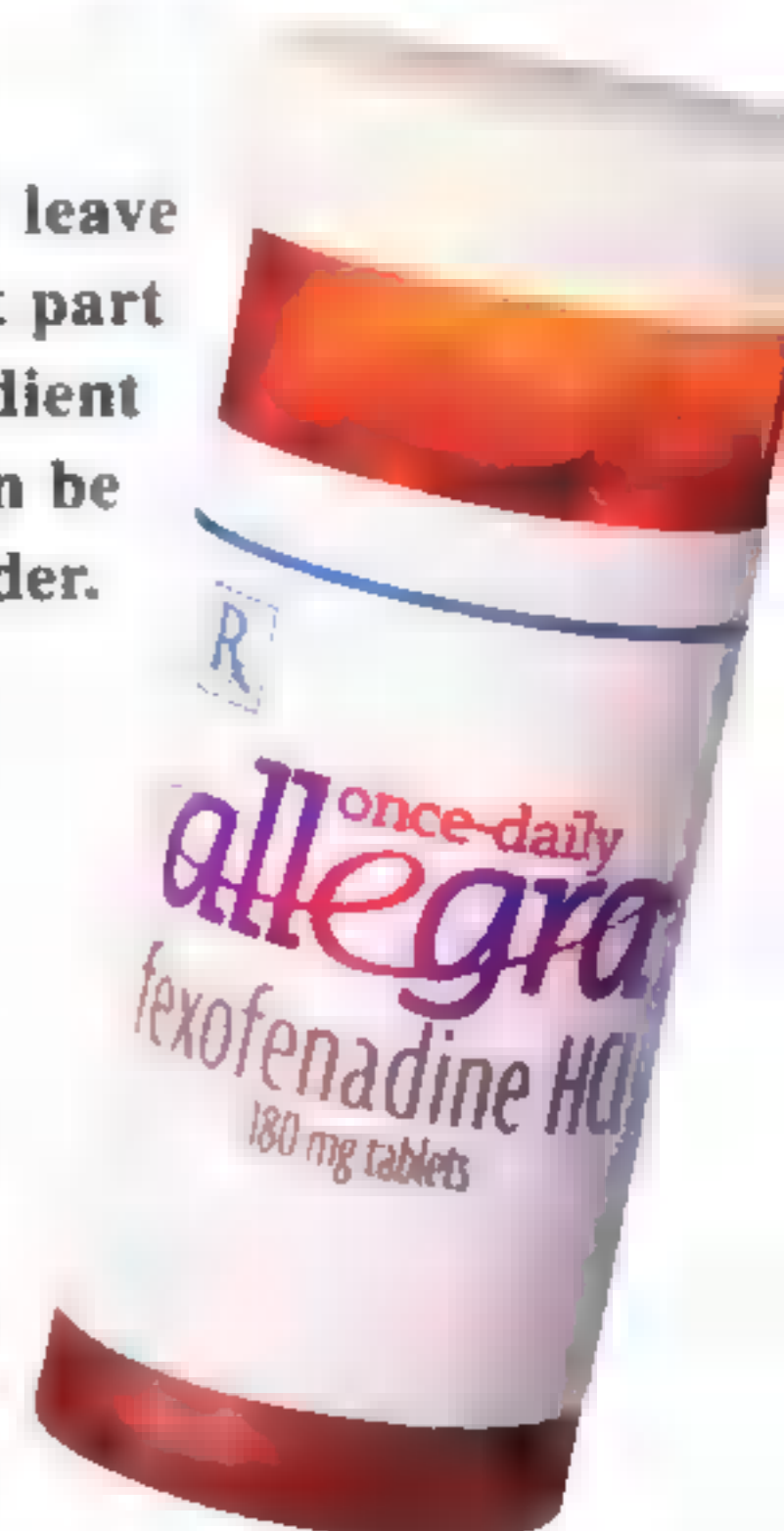
If you're one of millions who suffer from seasonal allergies, even a day of golf can leave you sniffing and teary-eyed. That's why once-daily Allegra can play an important part in treating your allergies. Only Allegra contains fexofenadine, an exclusive ingredient that provides long-lasting seasonal allergy relief without the drowsiness which can be caused by many antihistamines. So get back to your game. For people twelve and older. Side effects are low and may include headache, cold or back pain.

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Official Allergy Medication of the PGA TOUR Please see additional important information on next page.





**ALLEGRA®**  
(fexofenadine hydrochloride)  
Capsules and Tablets

**INDICATIONS AND USAGE**

**Seasonal Allergic Rhinitis**

ALLEGRA is indicated for the relief of symptoms associated with seasonal allergic rhinitis in adults and children 6 years of age and older. Symptoms treated effectively were sneezing, rhinorrhea, itchy nose/palate/throat, itchy/watery/red eyes.

**Chronic Idiopathic Urticaria**

ALLEGRA is indicated for treatment of uncomplicated skin manifestations of chronic idiopathic urticaria in adults and children 6 years of age and older. It significantly reduces pruritus and the number of wheals.

**CONTRAINDICATIONS**

ALLEGRA is contraindicated in patients with known hypersensitivity to any of its ingredients.

**PRECAUTIONS**

**Drug Interaction with Erythromycin and Ketoconazole**

Fexofenadine hydrochloride has been shown to exhibit minimal (ca. 5%) metabolism. However, co-administration of fexofenadine hydrochloride with ketoconazole and erythromycin led to increased plasma levels of fexofenadine hydrochloride. Fexofenadine hydrochloride had no effect on the pharmacokinetics of erythromycin and ketoconazole in two separate studies. Fexofenadine hydrochloride 120 mg twice daily (two times the recommended twice daily dose) was co-administered with erythromycin 500 mg every 8 hours or ketoconazole 400 mg once daily under steady-state conditions to normal, healthy volunteers (n=24, each study). No differences in adverse events or QT<sub>c</sub> interval were observed when patients were administered fexofenadine hydrochloride alone or in combination with erythromycin or ketoconazole. The findings of these studies are summarized in the following table:

**Effects on steady-state fexofenadine hydrochloride pharmacokinetics after 7 days of co-administration with fexofenadine hydrochloride 120 mg every 8 hours (two times the recommended twice daily dose) in normal volunteers (n=24)**

Concomitant Drug	C <sub>max,SS</sub> (Peak plasma concentration)	AUC <sub>(0-12h)</sub> (Extent of systemic exposure)
Erythromycin (500 mg every 8 hrs)	+82%	+109%
Ketoconazole (400 mg once daily)	+135%	+164%

The changes in plasma levels were within the range of plasma levels achieved in adequate and well-controlled clinical trials.

The mechanism of these interactions has been evaluated in *in vitro*, *in situ*, and *in vivo* animal models. These studies indicate that ketoconazole or erythromycin co-administration enhances fexofenadine gastrointestinal absorption. *In vivo* animal studies also suggest that in addition to increasing absorption, ketoconazole decreases fexofenadine hydrochloride gastrointestinal secretion, while erythromycin may also decrease biliary excretion.

**Drug Interactions with Antacids**

Administration of 120 mg of fexofenadine hydrochloride (2 x 60 mg capsule) within 15 minutes of an aluminum and magnesium containing antacid (Maalox™) decreased fexofenadine AUC by 41% and C<sub>max</sub> by 43%. ALLEGRA should not be taken closely in time with aluminum and magnesium containing antacids.

**Carcinogenesis, Mutagenesis, Impairment of Fertility**

The carcinogenic potential and reproductive toxicity of fexofenadine hydrochloride were assessed using terfenadine studies with adequate fexofenadine hydrochloride exposure (based on plasma area-under-the-concentration vs. time [AUC] values). No evidence of carcinogenicity was observed in an 18-month study in mice and in a 24-month study in rats at oral doses up to 150 mg/kg of terfenadine (which led to fexofenadine exposures that were respectively approximately 3 and 5 times the exposure from the maximum recommended daily oral dose of fexofenadine hydrochloride in adults and children).

In *in vitro* (Bacterial Reverse Mutation, CHO/HGPRT Forward Mutation, and Rat Lymphocyte Chromosomal Aberration assays) and *in vivo* (Mouse Bone Marrow Micronucleus assay) tests, fexofenadine hydrochloride revealed no evidence of mutagenicity.

In rat fertility studies, dose-related reductions in implants and increases in postimplantation losses were observed at an oral dose of 150 mg/kg of terfenadine (which led to fexofenadine hydrochloride exposures that were approximately 3 times the exposure of the maximum recommended daily oral dose of fexofenadine hydrochloride in adults).

**Pregnancy**

**Teratogenic Effects: Category C.** There was no evidence of teratogenicity in rats or rabbits at oral doses of terfenadine up to 300 mg/kg (which led to fexofenadine exposures that were approximately 4 and 31 times, respectively, the exposure from the maximum recommended daily oral dose of fexofenadine in adults).

There are no adequate and well-controlled studies in pregnant women. Fexofenadine should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

**Nonteratogenic Effects.** Dose-related decreases in pup weight gain and survival were observed in rats exposed to an oral dose of 150 mg/kg of terfenadine (approximately 3 times the maximum recommended daily oral dose of fexofenadine hydrochloride in adults based on comparison of fexofenadine hydrochloride AUCs).

**Nursing Mothers**

There are no adequate and well-controlled studies in women during lactation. Because many drugs are excreted in human milk, caution should be exercised when fexofenadine hydrochloride is administered to a nursing woman.

**Pediatric Use**

The recommended dose in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adults and pediatric patients and on the safety profile of fexofenadine hydrochloride in both adult and pediatric patients at doses equal to or higher than the recommended doses.

The safety of ALLEGRA tablets at a dose of 30 mg twice daily has been demonstrated in 438 pediatric patients 6 to 11 years of age in two placebo-controlled 2-week seasonal allergic rhinitis trials. The safety of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adult and pediatric patients and on the safety profile of fexofenadine in both adult and pediatric patients at doses equal to or higher than the recommended dose.

The effectiveness of ALLEGRA for the treatment of seasonal allergic rhinitis in patients 6 to 11 years of age was demonstrated in one trial (n=411) in which ALLEGRA 30 mg twice daily significantly reduced total symptom scores compared to placebo, along with extrapolation of demonstrated efficacy in patients ages 12 years and above, and the pharmacokinetic comparisons in adults and children. The effectiveness of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on an extrapolation of the demonstrated efficacy of ALLEGRA in adults with this condition and the likelihood that the disease course, pathophysiology and the drug's effect are substantially similar in children to that of adult patients. The safety and effectiveness of ALLEGRA in pediatric patients under 6 years of age have not been established.

**Geriatric Use**

Clinical studies of ALLEGRA tablets and capsules did not include sufficient numbers of subjects aged 65 years and over to determine whether this population responds differently from younger patients. Other reported clinical experience has not identified differences in responses between the geriatric and younger patients. This drug is known to be substantially excreted by the kidney, and the risk of toxic reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and may be useful to monitor renal function. (See CLINICAL PHARMACOLOGY).

**ADVERSE REACTIONS**

**Seasonal Allergic Rhinitis**

**Adults.** In placebo-controlled seasonal allergic rhinitis clinical trials in patients 12 years of age and older, which included 2461 patients receiving fexofenadine hydrochloride capsules at doses of 20 mg to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. All

adverse events that were reported by greater than 1% of patients who received the recommended daily dose of fexofenadine hydrochloride (60 mg capsules twice daily), and that were more common with fexofenadine hydrochloride than placebo, are listed in Table 1.

In a placebo-controlled clinical study in the United States, which included 570 patients aged 12 years and older receiving fexofenadine hydrochloride tablets at doses of 120 or 180 mg once daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 1 also lists adverse experiences that were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at doses of 180 mg once daily and that were more common with fexofenadine hydrochloride than placebo. The incidence of adverse events, including drowsiness, was not dose-related and was similar across subgroups defined by age, gender, and race.

**Table 1**  
Adverse experiences in patients ages 12 years and older reported in placebo-controlled seasonal allergic rhinitis clinical trials in the United States

Adverse experience	Twice daily dosing with fexofenadine capsules at rates of greater than 1%	
	Fexofenadine 60 mg Twice Daily (n=679)	Placebo Twice Daily (n=671)
Viral infection (cold, flu)	2.5%	1.5%
Nausea	1.6%	1.5%
Dysmenorrhea	1.5%	0.3%
Drowsiness	1.3%	0.9%
Dyspepsia	1.3%	0.6%
Fatigue	1.3%	0.9%

**Once daily dosing with fexofenadine hydrochloride tablets at rates of greater than 2%**

Adverse experience	Fexofenadine 180 mg once daily (n=283)	
	Fexofenadine 180 mg once daily (n=283)	Placebo (n=293)
Headache	10.6%	7.5%
Upper Respiratory Tract Infection	3.2%	3.1%
Back Pain	2.8%	1.4%

The frequency and magnitude of laboratory abnormalities were similar in fexofenadine hydrochloride and placebo-treated patients.

**Pediatric.** Table 2 lists adverse experiences in patients aged 6 to 11 years of age which were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at a dose of 30 mg twice daily in placebo-controlled seasonal allergic rhinitis studies in the United States and Canada that were more common with fexofenadine hydrochloride than placebo.

**Table 2**  
Adverse experiences reported in placebo-controlled seasonal allergic rhinitis studies in pediatric patients ages 6 to 11 in the United States and Canada at rates of greater than 2%

Adverse experience	Fexofenadine 30 mg twice daily (n=209)	
	Fexofenadine 30 mg twice daily (n=209)	Placebo (n=229)
Headache	7.2%	6.6%
Accidental injury	2.9%	1.3%
Coughing	3.8%	1.3%
Fever	2.4%	0.9%
Pain	2.4%	0.4%
Otitis Media	2.4%	0.0%
Upper Respiratory Tract Infection	4.3%	1.7%

**Chronic Idiopathic Urticaria**

Adverse events reported by patients 12 years of age and older in placebo-controlled chronic idiopathic urticaria studies were similar to those reported in placebo-controlled seasonal allergic rhinitis studies. In placebo-controlled chronic idiopathic urticaria clinical trials, which included 726 patients 12 years of age and older receiving fexofenadine hydrochloride tablets at doses of 20 to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 3 lists adverse experiences in patients aged 12 years and older which were reported by greater than 2% of patients (treated with fexofenadine hydrochloride 60 mg tablets twice daily) in controlled clinical studies in the United States and Canada and that were more common with fexofenadine hydrochloride than placebo. The safety of fexofenadine hydrochloride in the treatment of chronic idiopathic urticaria in pediatric patients 6 to 11 years of age is based on the safety profile of fexofenadine hydrochloride in adults and adolescent patients at doses equal to or higher than the recommended dose (see Pediatric Use).

**Table 3**  
Adverse experiences reported in patients 12 years and older in placebo-controlled chronic idiopathic urticaria studies in the United States and Canada at rates of greater than 2%

Adverse experience	Fexofenadine 60 mg twice daily (n=186)	
	Fexofenadine 60 mg twice daily (n=186)	Placebo (n=178)
Back Pain	2.2%	1.1%
Sinusitis	2.2%	1.1%
Dizziness	2.2%	0.6%
Drowsiness	2.2%	0.0%

Events that have been reported during controlled clinical trials involving seasonal allergic rhinitis and chronic idiopathic urticaria patients with incidences less than 1% and similar to placebo and have been rarely reported during postmarketing surveillance include: insomnia, nervousness, and sleep disorders or parosmia. In rare cases, rash, urticaria, pruritus and hypersensitivity reactions with manifestations such as angioedema, chest tightness, dyspnea, flushing and systemic anaphylaxis have been reported.

**OVERDOSAGE**

Reports of fexofenadine hydrochloride overdose have been infrequent and contain limited information. However, dizziness, drowsiness, and dry mouth have been reported. Single doses of fexofenadine hydrochloride up to 800 mg (six normal volunteers at this dose level), and doses up to 690 mg twice daily for 1 month (three normal volunteers at this dose level) or 240 mg once daily for 1 year (234 normal volunteers at this dose level) were administered without the development of clinically significant adverse events as compared to placebo.

In the event of overdose, consider standard measures to remove any unabsorbed drug. Symptomatic and supportive treatment is recommended.

Hemodialysis did not effectively remove fexofenadine hydrochloride from blood (1.7% removed) following terfenadine administration.

No deaths occurred at oral doses of fexofenadine hydrochloride up to 5000 mg/kg in mice (110 times the maximum recommended daily oral dose in adults and 200 times the maximum recommended daily oral dose in children based on mg/m<sup>2</sup>) and up to 5000 mg/kg in rats (230 times the maximum recommended daily oral dose in adults and 400 times the maximum recommended daily oral dose in children based on mg/m<sup>2</sup>). Additionally, no clinical signs of toxicity or gross pathological findings were observed. In dogs, no evidence of toxicity was observed at oral doses up to 2000 mg/kg (300 times the maximum recommended daily oral dose in adults and 530 times the maximum recommended daily oral dose in children based on mg/m<sup>2</sup>).

Prescribing Information as of November 2000

Aventis Pharmaceuticals Inc.  
Kansas City, MO 64137 USA  
US Patents 4,254,129; 5,375,693; 5,578,610  
www.allegra.com  
alib1100Ad



# AskUs

**TELL US**

What kind of animal would find this one attractive?

Think you know the answer? Go online to [nationalgeographic.com/ngm/tellus/0204](http://nationalgeographic.com/ngm/tellus/0204) and test yourself, or read it here in next month's issue.

**March answer:** A cumulus cloud (one approximately a quarter of a cubic mile in volume) could, depending on its density, weigh from 230 to 1,000 tons.

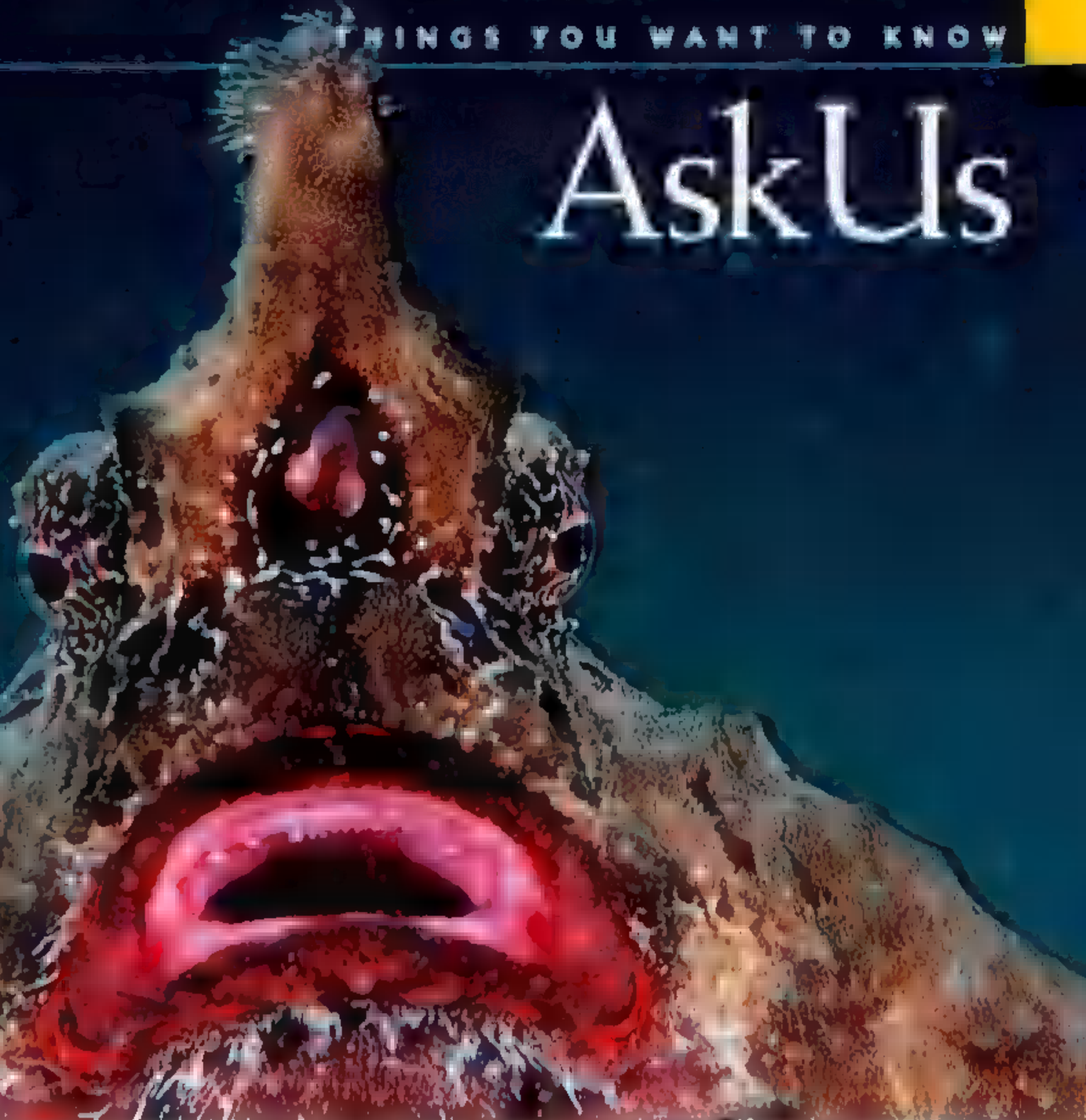


ILLUSTRATION BY DOUG BILLET

**THE ANSWER PLACE**

Our Research Correspondence staff responds to questions from curious readers.

**Q What library has the largest collection in the world?**

**A** With nearly 121 million items and approximately 530 miles of shelving, the Library of Congress in Washington, D.C., tops the list.

**Q When was the "second" first used as a unit of time?**

**A** Long before seconds marked time, they were used to represent a fraction of a circle or arc. Ptolemy borrowed the Babylonians' base-60 numerical system and applied units later named minutes and seconds to the measurement of spheres. The base was adopted to designate minutes on circular clock dials. Seconds, as time measurements, came along

late in the 17th century, when clock construction and design were refined enough to count off these small units.

**Q Do skunks ever run out of their spray?**

**A** "I've never met a skunk that was empty," says biologist Jerry Dragoo. While photographing an unwilling subject, he was sprayed nine times in 11 seconds and three more times just 90 minutes later. Such extreme discharge is rare in the wild, and predators usually scamper after one blast. Able to travel several feet, the sulfur-based spray can temporarily blind animals and cause nausea and breathing difficulties in humans. Even skunks dislike the stench of their offensive defense.

**Q How much land in the U.S. is owned by the government?**

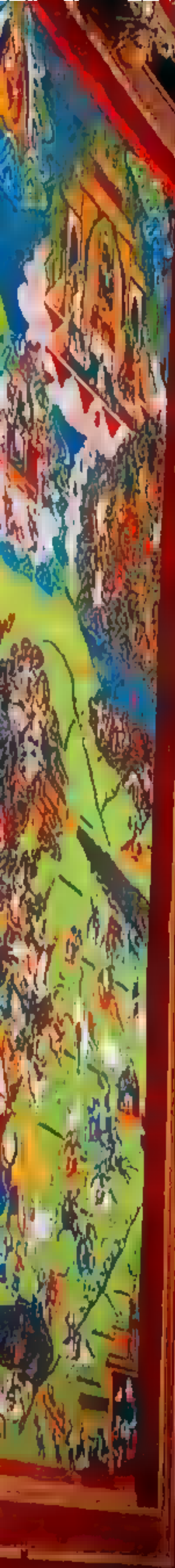
**A** Nearly a third of our 2.3 billion acres falls under federal

jurisdiction as parks, forests, monuments, wildlife refuges, trails, and other holdings. The notion of public lands dates from 1781 when New York, trying to appease the state of Maryland, ceded territory between the Appalachians and the Mississippi River to the federal government. Maryland had threatened not to sign the Articles of Confederation unless states with western land claims agreed to relinquish them. The state had no territory to reward its soldiers who fought in the Revolution and also feared that states with large land rights would gain too much power in the young country.

**MORE INFORMATION**

Send questions to Ask Us, National Geographic Magazine, P.O. Box 98199, Washington, DC 20090-8199 or via the Internet to [ngsaskus@nationalgeographic.com](mailto:ngsaskus@nationalgeographic.com). Include name, address, and daytime phone number.







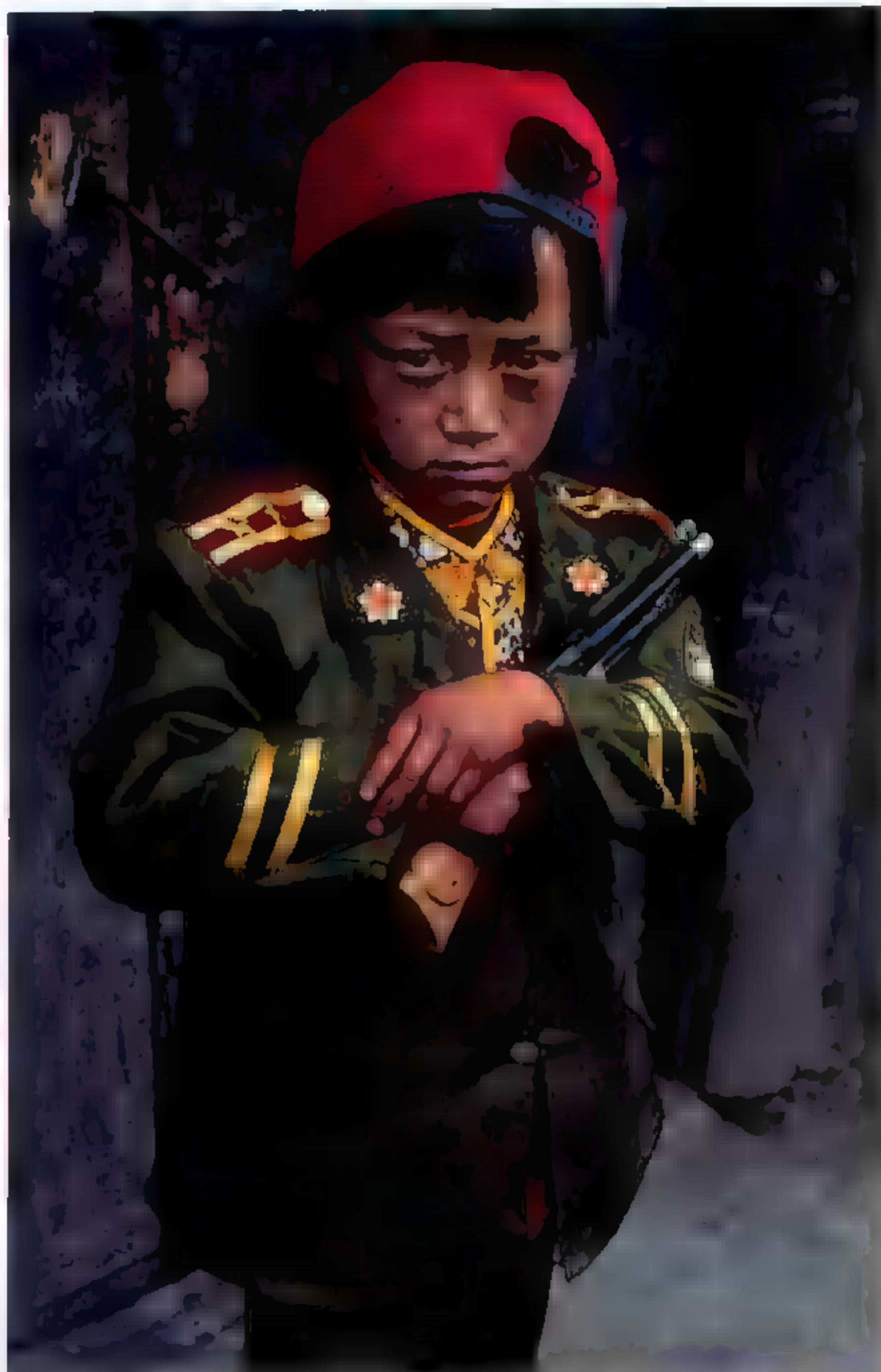


*In Tibet's capital city, Lhasa, an electric toy car brings earthly pleasure to a young monk taking a spin near the Potala Palace, once the seat of government and residence of the Dalai Lama.*



# Tibetans

Moving Forward  
Holding On



*Make-believe is loaded with irony when a Tibetan boy in the town of Lhagang dresses up as a Chinese policeman. Since the Chinese took over Tibet half a century ago, Tibetans have fought to keep their culture and religion alive. At Taktsang Lhamo monastery (overleaf), monks persevere in traditional attire.*



*A yak-dung fire warms a tent near Manigango. This family of nomads soon will move on with*





*their herd. China wants to settle such people, bringing them into the national mainstream.*




 A large, stylized, golden-yellow letter 'W' with a slight shadow, serving as a decorative element for the start of the article.

WATCHING HIS DAUGHTER on a homemade ladder smoothing varnish over the red-and-yellow trim of their large new log house, Norbu Choden smiled with the satisfaction that even if there was no getting the Chinese out of Tibet, he'd finally figured out how to benefit from their decades-long occupation of his homeland. "Once you understand that they're never going to help us," he said, "you realize that you have to make your own future."

Norbu made his by transforming himself from a herdsman to a middleman. Like many of the five million Tibetans living under China's flag, he'd spent nearly all of his 48 years in eastern Tibet driving shaggy yaks through alpine meadows, eating their meat and butter, living in a tent woven from their coarse black wool, barely getting by from one brutal winter to the next. Now he leaves the hard work to others, while he buys and sells for profit.

The middleman has a long and storied history among Chinese, but his vital economic role has largely eluded the grasp of Tibetans. Before Norbu's metamorphosis, he would look on with envy as Chinese from neighboring Sichuan Province arrived each spring, buying up a wrinkled little fungus that he and other nomads had dug from the ground in their spare time. The Chinese then sold the brown *Cordyceps*, known as caterpillar fungus, for huge profits to traditional medicine makers.

Gradually the thought took hold: If the Chinese can do it, why couldn't Tibetans? Why couldn't he? The government in Beijing had long since declared that personal wealth was no longer a social evil; indeed, Deng Xiaoping himself had said back in the 1980s that to get rich was "glorious." So, nervous but hopeful, Norbu sold off his animals two years ago and went into the *Cordyceps* business.

Earning as much as \$750 a pound from medicine makers in Chengdu, the Sichuan capital, Norbu made his risk pay off. Now he is by his own assessment a rich man. He displays the symbols of his new wealth: the coral-and-turquoise-studded jewelry he and his wife wear on their fingers and wrists, around their necks, and in their long, glossy black hair; the copper pots gleaming in the spacious log-walled kitchen; the sunny mountain mural in the main room. His rosy-cheeked wife still wears the *chuba*, the wraparound woolen robe traditionally favored by both women and men, but Norbu, tall and rugged, has switched to dark trousers and open-collared white shirt—what Tibetans refer to as "Chinese clothes."

Norbu says what satisfies him most is that he's used some of his wealth to help restore the Buddhist shrine, or stupa, across the dust-blown road from his house. For him, as with nearly all Tibetans,



No one wants  
the old  
theocracy.  
But no one  
wants the  
Chinese to  
remain in  
Tibet either.

Buddhism is a constant, overriding presence, involving never ending rituals to assure good fortune and, ultimately, rebirth. In Tibet, as in all Buddhist countries, the faithful erect stupas and place relics inside them to bring good to their lives. Norbu's shrine was one of thousands of religious structures destroyed by Red Guards during the decade-long Cultural Revolution launched in 1966; by the time it was over, youthful communist zealots had killed millions throughout China—including tens of thousands of Tibetans.

But Norbu represents the stubborn side of Tibetans. He and some of his neighbors recently won permission from the local government to reconstruct the stupa. "They told us that if we were willing to pay for it, we could do as we liked." Now freshly whitewashed and gilt trimmed, it resembles a giant upended ice-cream cone, gleaming in the brilliant sunlight.

FOR ME NORBU'S EXPERIENCES suggested the first tentative emergence of what could become a significant change in Tibet. More than a decade has passed since I was last there, after the Tiananmen Square massacre in 1989 and a previous civil uprising in Lhasa, the Tibetan capital. Martial law was in effect then, and foreigners weren't permitted to travel outside the city, where drab concrete Chinese buildings were already overwhelming traditional earthen and stone Tibetan architecture.

This time, though, I traveled more than 4,000 miles throughout the Tibetan Plateau, where 85 percent of the people live as subsistence herdsman and farmers. I also made side trips to Nepal, a funnel for escapees, and India, where 100,000 Tibetans live. There I spoke with the Dalai Lama, the Tibetan god-king who fled Lhasa in March 1959 and established a government-in-exile in northern India (see page 16). The 130,000 Tibetan exiles around the world still dream of the Dalai Lama marching triumphantly home to a newly independent Tibet.

This unrealistic hope has been weakening ever since 1965 when China separated most of the Tibetan Plateau from the rest of China and designated it the Tibetan Autonomous Region (TAR). Parts of the eastern Tibetan states of Kham (where Norbu lives) and Amdo were made into so-called autonomous prefectures and grafted onto the Chinese provinces of Qinghai, Gansu, Sichuan, and Yunnan. In reality neither the TAR nor the prefectures enjoy autonomy—they are as much under Beijing's thumb as any part of China, with dissent banned and dissenters punished. For this reason I have changed the names of most Tibetans in the story.

As with other Westerners, what I anticipated finding in Tibet today was heavily conditioned by the exile government's well-organized information machinery. The exiles admit almost no progress back in their homeland, and I expected a people and culture in deep decay. Finding Norbu and others like him, therefore, came as a great surprise. They are by any standard middle class, a breed of Tibetans that barely existed historically and is all but unknown to the outside world today.

Beyond these individuals I was also surprised to find signs of the



modern world spreading across Tibet: robed monks wearing sunglasses and riding motorcycles; nomads' tents powered by solar panels; slope-walled adobe houses sprouting TV dishes. At Gonsar monastery on the eastern plateau, 20,000 people massed for a week in a sea of white tents to pay homage to a five-story-tall golden Buddha statue newly installed in a hilltop shrine. While some came on horseback, more drove in trucks, vans, SUVs, and wagons pulled by coughing tractors.

The greatest shift taking place everywhere in China is that with economic freedom now a reality, people are becoming increasingly independent minded. Tibetans are beginning to follow, but slowly and fearfully. Initiative does not come easily to Tibetans, conditioned by Buddhism to be content with their lot—overwhelmingly as impoverished serfs and nomads—and to await happiness in the next life. Added to this, Beijing's spending on agriculture, transportation, and other infrastructure has helped foster a culture of dependence.

Even given their first signs of economic initiative, Tibetans are nowhere near achieving political self-determination. Although many

## TIBETANS IN ASIA



The high plateau west of China's heartland was once a Tibetan kingdom. After centuries of shifts in political power China took control in 1959, and 100,000 Tibetans fled to India. In 1965 China created the Tibetan Autonomous Region, which now contains fewer than three million Tibetans; two million Tibetans live in adjacent Chinese provinces.





*At altitudes of more than 12,000 feet, in mountain valleys like this near Kandze, farmers coax barley, wheat, and other staple crops from the soil. Though Lhasa teems with permanent residents and pilgrims (right), 85 percent of the five million Tibetans spread over the Tibetan Autonomous Region and neighboring Chinese provinces live in rural communities.*





Fervent lights the face  
of a pilgrim at the  
Buddhist assembly of  
Lhasa, China. Religion  
remains a source of  
inspiration and ethnic  
identity here, despite  
China's recent expul-  
sion of several thou-  
sand monks and nuns  
from the campus.

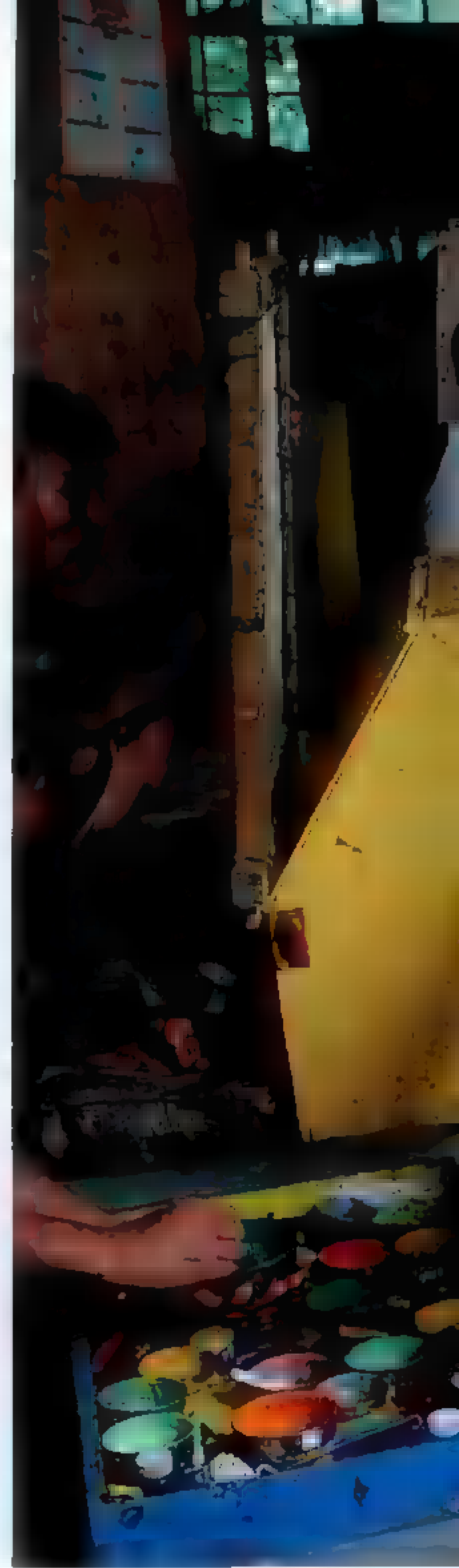








are loathe to accept it, the reality is that China is there to stay. Just as most Americans believe they are the legitimate owners of land once occupied by Native Americans, most Chinese say Tibet is a legitimate, historic part of the motherland. They'd no sooner return Tibet to the Tibetans than the United States would return South Dakota to the Sioux. And unlike the U.S., which had no prior claim on Indian territory, China does at least have an arguable historic claim on Tibet: Chinese emperors dominated Tibet during most of the 18th and 19th centuries. For more than 1,000 years before that, China and Tibet made war on one another repeatedly. Fortunes reversed again and again, at times leaving Tibet with the upper hand. China lost control early in the 20th



century before the communists took over Tibet once and for all in 1959.

During the Cultural Revolution China tried to commit cultural genocide by destroying almost all the holy places of Tibetan Buddhism, though it has since pursued a less aggressive policy. As a result the number of active monasteries has been cut from 2,500 before “liberation” to 1,800, and the number of monks is down from 120,000 to 46,000. Now the Chinese government is betting that as Tibetans continue to join the money race, they’ll become more pliant and less committed to the Dalai Lama and to what Beijing alleges is his scheme to split China by inciting rebellion in Tibet.

While Norbu is a devout Buddhist, rebellion is the furthest thing from his mind. He believes that he and others like him have the ability to improve their own lives and the welfare of Tibet. “We are taking our fate into our own hands,” he said. “By growing rich we’re able to support our religion and our language so that our children will be able to remain Tibetans.”

In fact, everywhere I went in Tibet, the faithful were still in evidence: pilgrims in dust-coated chubas and Mao-style padded blue jackets packed into open-bed trucks, heading for temples; worshipers carrying out the repetitive drills of Tibetan Buddhism—circumambulating

*Traditional arts have declined in Tibet but found a new life in exile. At the Norbulingka Institute near Dharmasala, India, students practice the exacting craft of painting a thangka, a stylized Buddhist scroll. Metalsmiths in training here created this copper statue of the Buddha—one of a thousand commissioned by the Dalai Lama.*





Buddhism is a  
**constant**  
presence,  
involving never  
ending rituals  
to assure  
good fortune  
and rebirth.

shrines and temples, always clockwise; passing loops of prayer beads through their fingers, keeping careful tally as they strive for millions of repetitions; twirling little prayer wheels around, around, around.

Once, driving at 14,000 feet in the eastern TAR, I nearly ran over two monks sprawled in the middle of a narrow dirt road. They were prostrating their way across the country to Lhasa, a thousand miles and two years distant. This is perhaps the most extreme expression of religious fervor in a society that honors extremes—but it isn't unusual. The monks, protected only by rawhide knee pads and wooden blocks strapped to their hands, lowered and extended themselves from toe to nose, scrambled to their feet, took two steps forward, then repeated the whole routine. After swerving hard and screeching to a halt, I got out and asked the men the obvious question. "For His Holiness the Dalai Lama," one replied after a moment's thought.

Everywhere, too, were the silent but dynamic signs of Buddhism and its affiliated animist culture. Hardly an hour would go by that I didn't pass outcroppings of rock with the Buddhist mantra chiseled in bas-relief: *Om Mani Padme Hum . . . Om Mani Padme Hum . . .* "Hail to the Jewel in the Lotus," again and again. Prayer flags—red, green, white, blue, yellow—strung from posts

(Continued on page 20)



# The Dalai Lama

## FACING A NEW REALITY

**H**AVING STRUGGLED FOR HALF A CENTURY to free his country from China's grasp, the Dalai Lama knows better than anyone that it's not going to happen. Even though he's been coming to recognize this near certainty for some time, he had held out hope until lately that as Beijing's hard-core communist leaders die, their more worldly successors might consider granting Tibet its independence.

Visiting Taiwan recently, the realization that virtually all ethnic Chinese, communist and capitalist, consider Tibet a rightful part of China was driven home for him. "All Chinese, even those I met in Taiwan, even those educated in the United States, think of Tibet as a part of China," he said, when I spoke with him in the comfortable stucco building that is his home and office in Dharmasala, a booming tourist town in the Himalayan foothills of India.

The best the Dalai Lama hopes for now is that the next generation of Chinese leaders will deliver some of the autonomy Tibet was supposed to receive after being declared an autonomous region in 1965. He bases this hope on a belief that Chinese politics will eventually follow its economics into a closer resemblance of the outside world. This would mean improved human rights for Tibetans as well as ethnic Chinese, he said. "China will have to follow the world, whether they like it or not."

While some might disagree, the Dalai Lama's judgment is to be taken seriously. Single-handedly he has recast Tibet from an obscure geopolitical issue into one of the great moral dilemmas of our time: either to side with the Chinese behemoth or to support a tiny group of impoverished people in their struggle to regain independence. Like the U.S., most countries have chosen to avoid publicly interfering while quietly backing the Dalai Lama's quest to

improve China's bleak human rights record in Tibet, which includes banning free speech and arresting Buddhist monks and nuns.

In his pursuit of better conditions for Tibetans, the Dalai Lama, seen here visiting Tashi Lhunpo monastery in southern India, is rarely in one place very long. Celebrated as a Nobel Peace Prize laureate, moral arbiter, public speaker, author, and spiritual leader, he's as at home in New York City or Paris as in Geneva or Tokyo. Some younger Tibetan exiles allege that the older generation has lost its fervor for returning to the homeland and has become bogged down in nepotism and other forms of corruption. Before meeting with the Dalai Lama, I asked his personal secretary, Tenzin Geyche Tethong, about these claims. "Yes, we've heard these charges before," Tethong said. "But there's never been a major allegation of corruption. I feel we've been successful in avoiding corruption."

I also asked Tethong about claims by China that Tibetan monks were in the habit of sexually abusing young boys and did so during the present Dalai Lama's rule. "There may have been some instances, but it was never widespread," he replied. Tethong added that he questioned the practice of admitting children as young as eight into monasteries—banned by China but still going on quietly. "In reality we find that some of the best scholars began as children," he said, "though I acknowledge that children don't really know their own minds at that age."

Moments later the Dalai Lama strode into



the sitting room. We exchanged white silk scarves, a formal Tibetan greeting, and took chairs catercorner from each other. Tethong and the Dalai Lama's American-educated nephew, Tenzin N. Taklha, fielded translations when he stumbled over a word or thought, which he does with some frequency.

This was the fourth time in 30 years I'd interviewed the Dalai Lama—whose title means “ocean-wide” and implies vast wisdom—and on each occasion I have found him tranquil and

Buddhism better,” he said. “Certainly these people have a very important role in the preservation of Tibetan culture. But when I think of culture, I think of internal things, like the quality of the mind, honesty, compassion, peacefulness. These are the qualities of our culture.”

These are the qualities he himself drew on after escaping to India in 1959. He was 24 years old, the 14th Dalai Lama in a line stretching back to the end of the 14th century. Although he had traveled to China and India, he was largely sheltered from the rough and tumble of politics and remained naive of the world beyond the Himalayan barrier. He'd been raised to be a demigod, worshiped from afar by his people. To Tibetans he was divine, the direct reincarnation of the Bodhisattva Avalokiteshvara, the ancestor of the Tibetan people. As far as the outside world was concerned, the Dalai Lama, like Tibet itself, was more myth than reality.

While his earthly power then was based on the immense army of monks he commanded, the Dalai Lama said he disagrees with those who argue that the smaller number of monks today prevents them from strengthening religion. “I always emphasize quality over quantity. Numbers are not so important.” He readily acknowledged that during his time in Tibet “too many people became monks just to earn a living.”

Although at 66 he appears healthy and vigorous, the time is coming when a successor must be found. In accordance with tradition, after a Dalai Lama dies, he is reincarnated in an infant who is sought out by a team of senior lamas. In the interim a regent has run Tibet. Since years may pass before the reincarnation is discovered, and still more before the boy reaches maturity and is enthroned, the regents have always wielded great power.

Over the centuries China periodically inserted itself into the selection process to increase its control of Tibet. It's a foregone conclusion that it will do so the next time, with China choosing its own candidate while the exile government selects another. Such interference could unleash a level of turmoil never known before in Tibet. □



almost tangibly spiritual. This time we spoke mainly of change: in Tibet, in China, among Tibetan exiles, in himself. I told him about the new breed of entrepreneurs I met in Tibet and asked what he thought of their effort to rebuild temples and stupas. I expected him to endorse their efforts. Surprisingly, he did not.

“I wish those wealthy Tibetans would spend their money on schools and clinics and on living









*Lighthearted rough-housing punctuates an afternoon session of Buddhist dialectics at a monastery in Bylakuppe, India. A vital part of all Buddhist monks' training, such debates are characteristically lively among Tibetans.*



(Continued from page 15) and trees like pennants on a sailing ship fluttered their appeals heavenward. At high passes and across table-flat pastures, rocks the size of bread loaves were stacked meticulously into squared-off cairns—more modest versions of stupas. Chinese authorities, despite their paranoia about religion, evidently don't consider these symbols dangerous.

**W**HILE RELIGION IS CRUCIAL to Tibetan culture, the language—incomprehensible to Chinese, almost none of whom bother to learn it—is the second pillar of Tibetan identity. In this as well the new entrepreneurs are helping, financing schools and colleges to teach Tibetan to young Tibetans, who are in danger of losing their language as they become proficient in Chinese, the language they must use if they're to get ahead.

One of these young people—Sonam—traveled with me as guide and interpreter; he was fluent in Tibetan, Mandarin, and English. We met in Chengdu in Sichuan Province, but before starting out, Sonam wanted to receive a blessing from a friend, a lama, who was in town. This senior monk, in his early 60s, told me he'd sat out 30 years of “liberation,” Cultural Revolution, and other Chinese-inflicted horrors as a hermit, meditating in a cave. Five years ago, having reached the level of spiritual





*Prayer stones left by pilgrims blanket a sacred site near Jyekundo. Carved and painted motifs include mantras and meditation deities. To earn good karma, pilgrims circumambulate Labrang Tashikyil (below right), one of the few monasteries that survived the Cultural Revolution, when the Chinese destroyed thousands of religious centers in Tibet.*



growth he was seeking, he rejoined the world and found that Chinese were fascinated by his story. He was now on the lecture circuit, spreading Tibetan Buddhism to born-again former communists.

The lama received us in his room in a bare-bones hotel where he and a large party of aides—monks, nuns, and laypeople—occupied two entire floors. As he sat cross-legged on his bed, wrapped in a maroon robe, his young assistants flowed silently in and out with an endless stream of plastic trays bearing foam cups of instant noodles, hard candies, apples, bananas, cheese, buttered tea, and Coca-Cola. All had been paid for by the lama's followers—including some wealthy Chinese women.

Tibetan Buddhism, said the holy man, was becoming fashionable among sophisticated Chinese. "Some of it is due to their awareness that Buddhism is popular with famous American movie stars," he said, "and part is because their lives are empty and they feel a need to fill that emptiness with spirituality." In addition, he said with a vague smile, some are attracted by a misunderstanding of tantric practice, an esoteric element of Hinduism and Tibetan Buddhism, which they associate with a more erotic sex life.

After taking our leave, Sonam and I headed west toward Tibet. An hour or so out of town, the four-lane superhighway gave way to lesser roads, some newly paved, some barely there, some holed deep enough to



swallow our car, others terrifyingly narrow enough to drop it, and us, into bottomless ravines. Accommodations, too, deteriorated: Within a couple of days in Tibet, we slipped from hot water to cold to none; from indoor toilet to outdoor privy to a squat in the bushes; from clean linen to questionable to probably-never-washed to bare mattress.

Along the way I encountered my most enduring image from anywhere in Tibet: thousands of men and women—Chinese and Mongols as well as Tibetans—digging, hammering, blasting, pouring concrete, cooking tar, and meticulously assembling rough stone into towering retaining walls as they pushed an expanding web of roads mile after mile



*Neon illuminates a nightclub in a Lhasa district  
of new hotels, shops, and bars. Customers are  
mostly Chinese, whose growing presence, and  
wealth, has transformed the capital.*



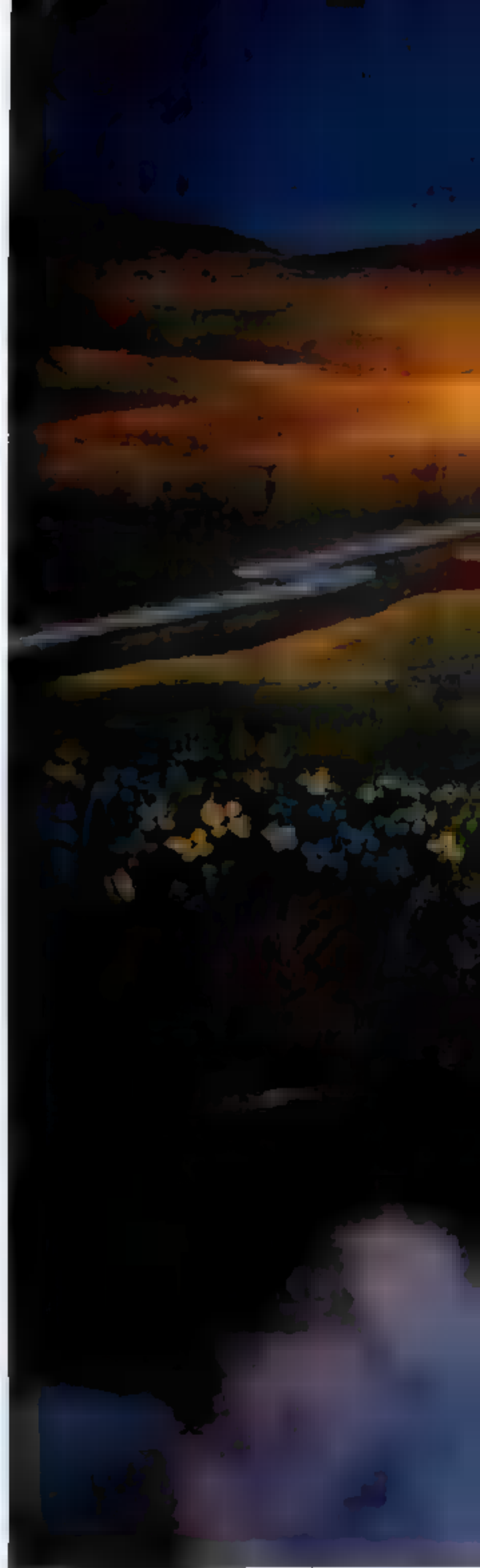






westward through the mountains and across the great Tibetan Plateau.

Like the long knives Tibetan nomads hang from their belts, new roads into Tibet can cut deeply, slicing away millennial layers of isolation and ignorance, clearing access to the world and to almost anything money can buy. But the roads can also cut into a rich—and fragile—culture. Still, although I found no shortage of Tibetans who damned the Chinese, few criticized the roads. “We have to admit that only China could accomplish this,” a farmer with a brown walnut of a face, astride a wheezing one-lung motor tricycle, told me as we waited more than four hours for a pick-and-shovel gang to clear a rock slide. “Our own government never did and never could.”



This mammoth construction project is key to Beijing’s “Develop the West” program, intended to modernize the lagging economy of western China, which includes the Tibetan Plateau. The eventual objective is to fill this open territory—as vast as Western Europe—with millions of Chinese now living in economically deprived parts of China. Just as Horace Greeley advised an earlier generation of ambitious young Americans to go West, the authorities are urging Chinese to move in the same direction. So far results have been mixed, because lowland Chinese find the altitude, the dry, cold climate—and the Tibetans themselves—unwelcoming. Beijing’s statistics, widely considered extremely low on this point, show that 122,000 Chinese are now living in Tibet. Those who do migrate generally stay no more than a couple of years, just long enough to save some money, before returning home.

Mutual animosity runs high: Chinese despise Tibetans as ignorant, lazy, superstitious, and dirty. Tibetans hate and fear the Chinese as cruel and moneygrubbing. The resident Chinese seem genuinely puzzled by the antagonism. “We’re bringing them the benefits of a superior culture,” a couple running a tiny Chinese restaurant in the Wild West town of Dari, near Sichuan Province’s boundary with the TAR, told me, with what sounded like utter sincerity. “We don’t understand why they don’t

*In a Lhasa cabaret, secular music shares the stage with the illuminated image of a sacred shrine known as a stupa—a pairing that many traditional Tibetans would find deeply offensive. Just down the road, prostitutes tend to their knitting as they wait for customers—likely Chinese laborers in town for construction jobs or Chinese soldiers from a nearby army base.*





The Chinese  
are feeling  
that as more  
Tibetans join  
the money  
race,  
they'll become  
more powerful.

welcome us with open arms." They didn't understand either how numbing it must be for people with an ancient culture to realize that their country is permanently occupied by what they consider to be a foreign government, or how disquieting it is when a convoy of olive-drab trucks loaded with grim-faced armed Chinese troops rumbles past a village. I passed these convoys on several occasions, and each time I noticed that the Tibetans on the roadside would glance up, then quickly look away, fearful of making eye contact with a Chinese soldier.

A sign of why Tibetans resent the Chinese can be seen, at a distance, in the form of brick-and-stone-walled compounds sprinkled across the Tibetan Plateau—the *laogai*, "reform through labor" camps. Statistics on the prisoners in these camps are almost meaningless: Beijing claims that in 1995 there were 685 camps holding 1.2 million prisoners throughout China. Harry Wu, a former inmate now living in the U.S. and known around the world for his indefatigable struggle against the Chinese authorities, insists there are nearly twice as many camps and up to eight million prisoners across the country. Perhaps 10 percent of them are held for their political activities. According to Wu, camps in the TAR hold some 4,000 Tibetans, and countless thousands more are imprisoned in neighboring provinces. He says the Tibetans, along with







other prisoners, are tortured and forced to work at hard labor and produce cheap goods for international trade; officially they are spared another indignity: the government's harvesting of bodily organs for sale.

Tibetans I met acknowledged that along with oppression China has brought a standard of living far higher than that of their parents under the Dalai Lama's rule. The Chinese have built hundreds of schools, where until the 1950s there had been just a handful of nonreligious schools. They've built hospitals. Everywhere I traveled, they'd halted deforestation and are replanting trees, having learned through bitter experience in the summer of 1998 that the denuding of Tibet caused the Yangtze to flood, drowning 4,000 people. They've built airports and are

*Draping a hillside, monks unroll a grand silken thangka for a festival at the Drepung monastery, damaged during China's Cultural Revolution. Though events like this have been revived and monasteries are being restored, some Tibetans still flee their homeland. In Dharmasala, Ama Adhe (right), who left Tibet in 1987 after 27 years in prison for resisting Chinese rule, recounts her experiences for newly arrived refugees.*



beginning the first Tibetan railroad. They've also installed a telecommunications network, one that enabled me to dial directly to the U.S. Despite having a phone line to India, the best the Dalai Lama could do to send word across Lhasa from the dim recesses of the Potala Palace was to dispatch a runner.

Yet Tibetans almost invariably also said that China was implementing development solely to help exploit Tibet's natural resources. "Their goal is to extract all our treasures"—timber, wildlife, gold, uranium—"and to make China rich and powerful," said a man in his late 20s in Chamdo, a town on the banks of the Mekong River.

**I**T IS IN ROUGH-HEWN TOWNS like Chamdo that China's colonization is most noticeable. Along streets either ankle deep in putrid mud or swirling with choking red dust, the air foul with sour, eye-burning smoke from yak-dung cooking fires, new Chinese arrivals throw together featureless concrete shops, restaurants, and brothels to serve the needs of the road crews and other transient laborers. The new one- and two-story buildings bear signs in two languages—Tibetan script on top and larger Chinese characters below.

As thankless as I found these towns, dirt-poor Tibetan nomads are as









*Re-creating the Red Army's 1950 march into eastern Tibet, soldiers act in a Chinese film. Tibetans see this march as an invasion; the Chinese see it as a liberation from backwardness.*



dazzled as the proverbial rubes who see Times Square for the first time. Herdsmen in filthy chubas roam the dirt streets in clusters, gawking into storefronts at Chinese women in short dresses cutting customers' hair or chatting over cans of Coca-Cola. A single tube of pink or purple neon in the window of a brothel can be as exciting as all the lights of Broadway. "I would like to go in," said a man in his 20s with lank, shoulder-length hair, in the little town of Jamdun, a few miles east of the Mekong River. "But I have no money." Few Tibetans do, but that doesn't stop them from aspiring to the pleasures of the towns. And Beijing seems to be counting on that hope to eventually win Tibetan hearts and minds.

One soft evening in the northeastern corner of the TAR, I shared dinner with Huadon and his wife, who—despite having suffered, as he put it, "the full misery of liberation and the Cultural Revolution"—seem to be bearing out that hope.

Both 54, they'd lost family members among the more than a million Tibetans killed since 1950; they'd never been to school; Huadon had been frustrated in his boyhood dream of becoming a monk. After the agricultural commune where they lived during the Maoist era of the 1950s and '60s was disbanded, they began growing barley, the staple of the Tibetan diet. They scrimped and searched for business opportunities. Now Huadon owned a small cement plant and a general store,





*Wall-to-wall Tibetan carpets are readied for export at a factory in Kathmandu, Nepal. Owner Kalsang Choe-wang, himself the son of a merchant, lived in Tibet at the foot of Mount Everest until he was nine. For most Tibetan exiles, such as dairy farmers coping with the heat and humidity of southern India, life abroad has required a far bigger adjustment.*



which his wife ran, and a blue pickup truck. Despite his lasting anger over the past, Huadon didn't hesitate to tell me that "there's no comparison between the way we live and the way our parents did."

Huadon and his family certainly seemed comfortably off. As is the custom each summer throughout rural Tibet, they and about 20 other families were spending three weeks relaxing, camped in a grassy field riotously spread with yellow and lavender wildflowers against a stunning backdrop of snow-streaked mountains. A hacking gas-powered generator, a sure indicator of rural prosperity, provided electric light and pumped Tibetan and Chinese pop tunes over the fancifully embroidered large white tents.

At the open front of their tent, Huadon's wife was cooking on a portable gas stove. She'd loaded a long table with dried yak meat, huge mutton ribs—which we ate with a hunting knife passed from hand to hand—bowls of steaming rice and curry, salted nuts and seeds, cookies, candies, watermelons, bottles of tepid Chinese beer, soda, juice, and water. "This is our time for forgetting everything and to eat and drink and have fun," said Huadon, as we raised unending toasts.

I asked about their three children. The couple had sent their elder son through college, and he was now working as a teacher. Their daughter was a Buddhist nun. And, to Huadon's great joy and satisfaction, their



younger son, at 16, was becoming the monk Huadon hadn't been allowed to be. The Chinese government bans monastic education before the age of 18, but devout parents like Huadon quietly ignore the law. "I believe that my son and his generation will save Buddhism and Tibetan culture," he said.

People like Huadon and Norbu, who use their participation in the new economy to help preserve the old ways, represent the leading edge of change in Tibet. I spent my most comfortable night of the trip in a shiny new hotel in the burgeoning town of Jyekundo, a few hours drive from Huadon's camp. Proud of his success, Gama Sera, the owner, was





pleased to let me use his real name. "I was working for a state-owned bank and came to realize that because of this town's location at the juncture of six counties, a decent hotel could do well here. So I proposed that the local government lease me the state guesthouse for 20 years. Very quickly, they agreed."

The result was a multistoried, tile-faced structure replete with gilt dragons on red-lacquered pillars, a glass-domed lobby with marble floor and electric-eye doors. Clean rooms, clean beds, clean bathrooms, fresh towels, soap, toilet paper, TV spouting Chinese dramas and advertisements for luxury condominium communities in Beijing, and, most delicious after days of red dust and no showers, the prominently advertised "24-hour hot water."

Gama Sera, too, is contributing to the rejuvenation of Buddhism. With his earnings, he said, "I'm helping support a lama whose teachings I follow."

With religious practice woven so inextricably through the fabric of their lives, and with China having systematically undermined it, the Tibetans' fear of cultural genocide is well-founded. Although individuals are permitted to worship, owners of photos of the Dalai Lama, which are seized from temples and even personal shrines, have been

*Western pop stars are fixtures at the Tibetan Children's Village, a school in Dharmasala where students get a grounding in their native language and culture. Such teaching is limited in Tibet. Following tradition, monks in Bylakuppe start their training early; the law in Tibet now bans novice monks under the age of 18.*





jailed for as long as six years. Monks feel the lash of Chinese control most severely. In the Dalai Lama's day the power of the religious establishment was complete. Nearly a fourth of all Tibetan males took the tonsure and maroon robes of monkhood. The great monasteries counted members in the thousands and owned huge tracts of farming and grazing land. They enjoyed the right to use peasants as laborers and to recruit little boys, some of whom they may have used for sex. Claiming moral outrage, although in reality far more concerned with loosening Buddhism's hold on Tibetans, the Chinese have jailed thousands of monks during their occupation.

In Lhasa, I spoke with 73-year-old Tashi Tsering, who also allowed me



to use his real name. He said that at the age of ten he'd been recruited into the Dalai Lama's dance troupe and chose to become a *drombo*, or passive sex partner, for a senior monk. Tsering, who has written a book about his life, said the *drombo* practice was widespread, but I was unable to find any other Tibetan willing to acknowledge awareness of this sexual activity in the monasteries.

Lhasa is the spiritual focus of Tibetan Buddhism, and in the heart of the city is the Potala, the deep-red, 13-story hilltop palace that has been the residence of all Dalai Lamas since the 17th century. The Potala is now a museum, and fewer than a dozen of its thousand rooms are open to visitors. Bored Chinese tour guides deliver rote recitations on paintings and statuary in a smattering of languages. I found a few men hanging around languidly in the dim halls, mainly for atmosphere, I thought. But like Tibetans I encountered elsewhere, they were willing to risk being caught to let a foreigner know their true allegiance. One, prayer beads in hand, sidled up to me and whispered, "I love the Dalai Lama. I think of him every day."

The monastic establishment today is a faint shadow of what it had been before the Dalai Lama fled Lhasa just steps ahead of the People's Liberation Army. I visited six monasteries, and at each one the nervous

**The 130,000  
Tibetan  
exiles  
still dream of  
the Dalai Lama  
returning to an  
independent  
Tibet.**





*Normal living in the post-revolution*



*Worshiper at a temple in Batang, Kham*



*Pilgrims at the Jokhang Temple in Lhasa, Tibet*





*Wedding guest in Shigatse, Kham*



*Passenger in Lhasa, Tibet*



*Folk dancer in Dharamsala, India*



*Girl in a new Chinese coat in Shigatse, Tibet*



whispers were the same: By reducing the number of monks, the Chinese are attempting to destroy our religion.

**A**T DERGE, an 18th-century town carved into the side of a ravine rising steeply off the east bank of the Zi Qu tributary of the Yangtze, I met two men in their 20s. For protection, I will not identify their homes, but they'd been traveling by truck for nearly a month, and now they, as I, were gawking at the Derge Parkhang. This exquisite carmine, gilt-roofed, three-story printing house, which looks like a temple rather than a factory, was built in 1744 to produce traditional unbound books of religious and medical texts. During the 1960s troops of the People's Liberation Army occupied the building, gravely damaging it. The Chinese government, always in search of tourism income, restored it and opened it to visitors in the late 1990s.

Led by a Chinese government guide, after paying the 20-cent admission fee (no charge for Tibetans), we walked past walls newly painted with religious murals of fantastic demons and through unlit rooms lined with floor-to-ceiling racks holding 270,000 ancient wooden printing plates that had survived the Chinese army and subsequent neglect. Tibetan men, many physically disabled, sat by threes on the floor, each team slathering the plates with thick black ink, pressing them onto





*Following age-old rhythms, a monk takes plodding transport to a town in the cold, windswept county of Sershul, where he will conduct a prayer ceremony. For now at least, it is largely in such out-of-the-way corners of western China that traditional Tibetan culture endures.*



sheets of rough paper, and peeling off some 2,500 pages an hour of the classical texts. This impressive output, sold inexpensively in bookshops throughout Tibet, appeared to contradict allegations among Tibetans living abroad that the Chinese ban Tibetan-language publishing.

After the tour, as I chatted with the two men, it became evident that they knew a great deal about the tribulations Tibetan monks face today. "Fifteen times a year Chinese officials visit the monasteries and conduct 'patriotic education' classes," said the younger man. "Each class lasts two or three hours. Basically they tell the monks that the Dalai Lama is evil and that he wants to split the motherland. The monks must pretend to listen, but most manage to block it out by chanting silently to themselves." Afterward the monks try to erase anything that might have seeped in by listening to Voice of America Tibetan-language broadcasts on shortwave radios.

In an attempt to counter the impact of the age ban on monastic life, they said that the monks smuggle in boys as young as eight and begin training them in secret. "No one wants to become a monk when they've already danced with girls," the older one said with a little chuckle as he glanced at two gum-chewing young women in diaphanous chubas, tottering past our table on platform shoes.

One afternoon on a roadside in eastern Tibet, I spoke with a monk I'd waved down to ask directions. He told me about his monastery, which once held 500 monks and 300 students and had seen those numbers more than halved by government edict. Like other monks I spoke with, he measured the strength of Buddhism by the length of monastic rolls. "Only when we're many," he said, "can we properly teach the people that it is much better to be poor, as long as you have your faith and know that peace is coming, than it is to live in a concrete house, wear Chinese clothes, and have a lot to eat, if you're not at peace."

Not all Tibetans agree. "One of the main reasons Tibet was so backward is that too many men were in the monasteries and not contributing toward development," said Arzong, a 39-year-old instructor at the Tibetan Language School in eastern Tibet, about 300 miles southeast of Derge. "I continually advise parents to send their children to schools, not to monasteries. Otherwise, our population will remain stagnant, and we'll never be able to compete economically."

In his large, sparsely furnished office, Arzong demonstrated that he was able to communicate on the Internet in Tibetan. "The truth," he said, "is that there are plenty of Tibetan books and literature available, both electronically and in print." Over the summer he was writing a volume on Tibetan grammar for use by teachers and was editing a collection of folktales. He conceded, though, that the only reason for young people to learn their ancestral language was "to preserve Tibetan nationalism."

In these ways do the old and new, tradition and change, exist uneasily side by side. Among the Tibetans, even while those like Norbu, Huadon, and Gama Sera are embracing change, I found a people conflicted by that change. Some candidly acknowledge the hardships and inequities of life under the Dalai Lama. Others grudgingly concede economic progress under China. No one wants to return to the old, often abusive, theocracy. But no one wants the Chinese to remain in Tibet either. They don't miss the old days and its old ways. They simply want their country back. □

**MORE WEBSITE**

Take a multimedia tour of Tibet. Find related websites, more photos, and tales from the field at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204).  
AOL Keyword: NatGeoMag



# MANELESS

**TSAVO IS A DANGEROUS PLACE, AND IT BREEDS TOUGH LIONS. THEY'RE SAID TO ATTACK LAND ROVERS, RAID TENT CAMPS, AND STALK TOURISTS. THEY MAY BE BIG AND BAD, BUT WHY ARE THEY BALD?**





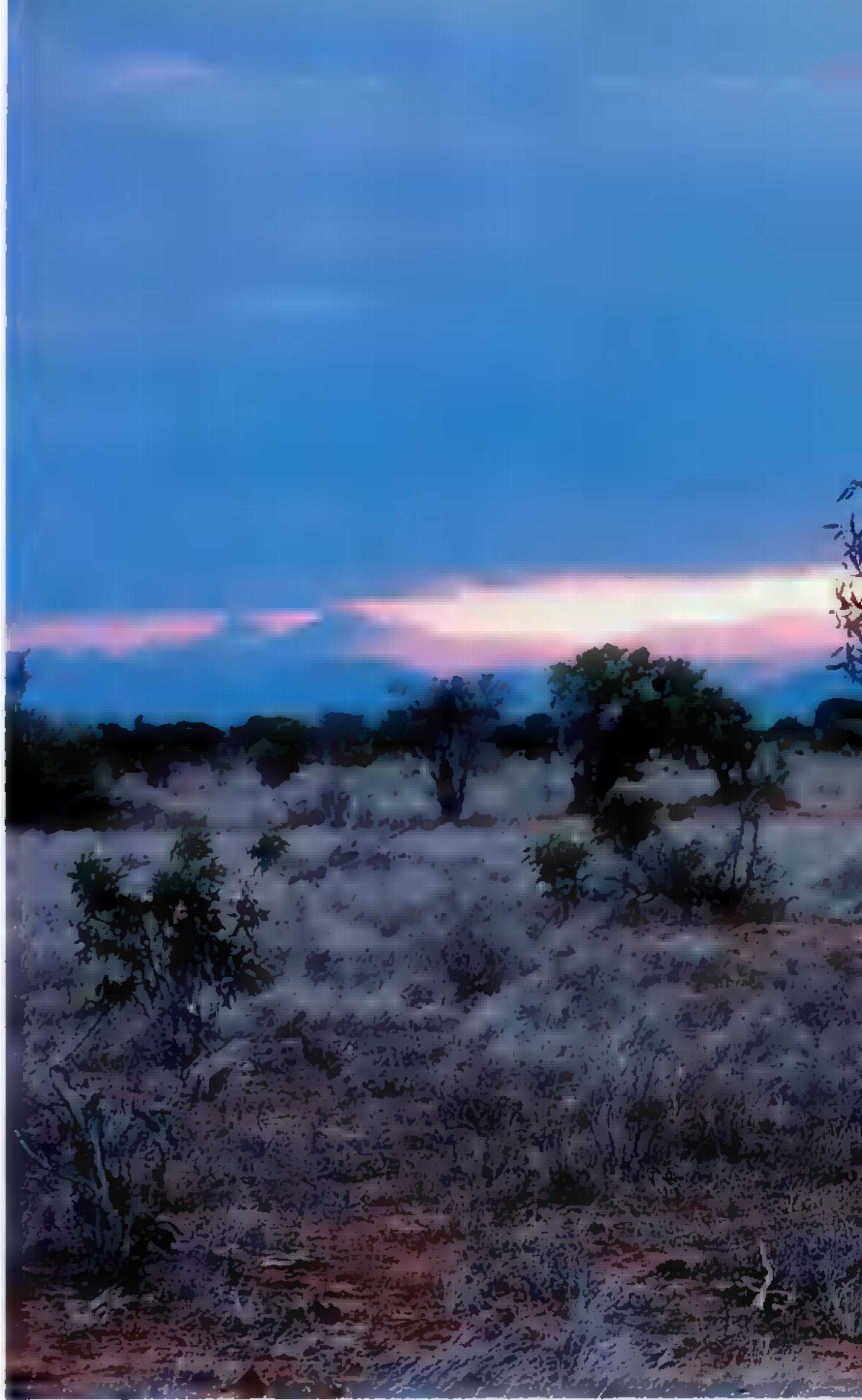
# INTSAVO



The face is familiar, but this lion lacks the glorious headdress that gives males their regal air. He and his raggedy kind somehow survive on the thirsty plains of Kenya's Tsavo East National Park.



**BY PHILIP CAPUTO  
PHOTOGRAPHS  
BY ROBERT CAPUTO**

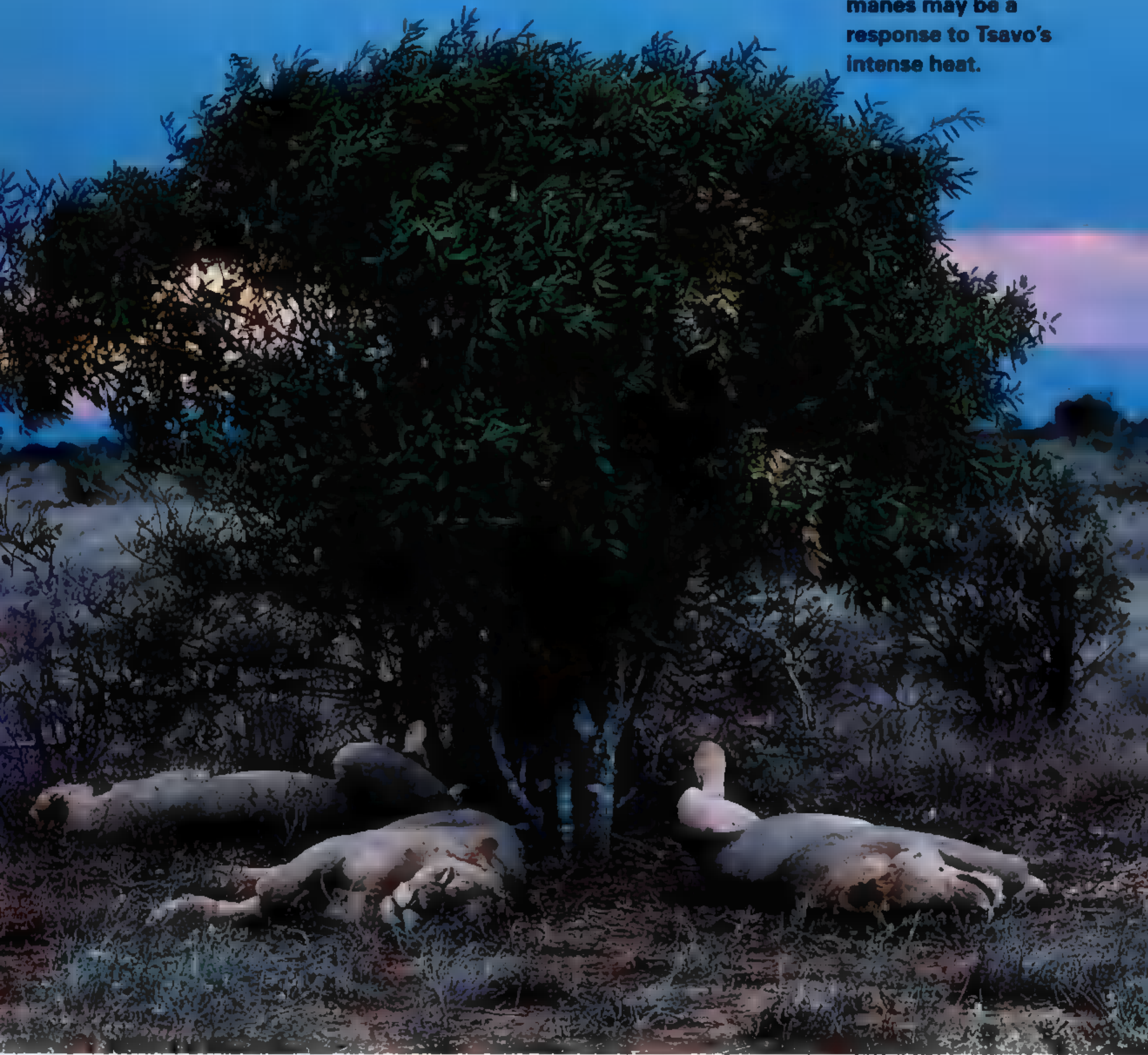


**We**

were awake before dawn, the Southern Cross shining brilliantly in a sky as black as when we'd gone to bed. After a hurried breakfast Craig Packer and I left camp in a Land Rover to look for the maneless male lions for which Kenya's Tsavo East National Park is famous. The dusty road appeared as a trail of white ash in the headlights, and a pair of hyena eyes glowed back at us from out of the dense underbrush crowding the roadside. Full daylight arrived before we reached our destination, the stark Ndara Plains. There we turned right at a junction, passed a dry water hole, and rounded a bend. Craig braked to a quick stop. Fifty feet away three male lions lay by the road. They didn't appear to have a hair on their heads. Noting the color of their noses



**Weary lions rotate with the shade, resting some 20 hours a day. Their sparse manes may be a response to Tsavo's intense heat.**



(leonine noses darken as they age, from pink to black), Craig estimated that they were six years old—young adults.

“This is wonderful!” he said, after staring at them for several moments. “This is what we came to see. They really *are* maneless.”

Craig, a professor at the University of Minnesota’s Department of Ecology, Evolution, and Behavior, is arguably the leading expert on the majestic Serengeti lion, whose head is mantled in long, thick hair. He and Peyton West, a Ph.D. candidate who has been working with him in

Tanzania, had never seen the Tsavo lions that live some 200 miles east of the Serengeti. The scientists had partly suspected that the maneless males were adolescents mistaken for adults by amateur observers. Now they knew better.

The Tsavo research expedition was mostly Peyton’s show. She had spent several years in Tanzania, compiling the data she needed to answer a question that ought to have been answered long ago: Why do lions have manes? It’s the only cat, wild or domestic, that displays such ornamentation. In Tsavo she was attacking





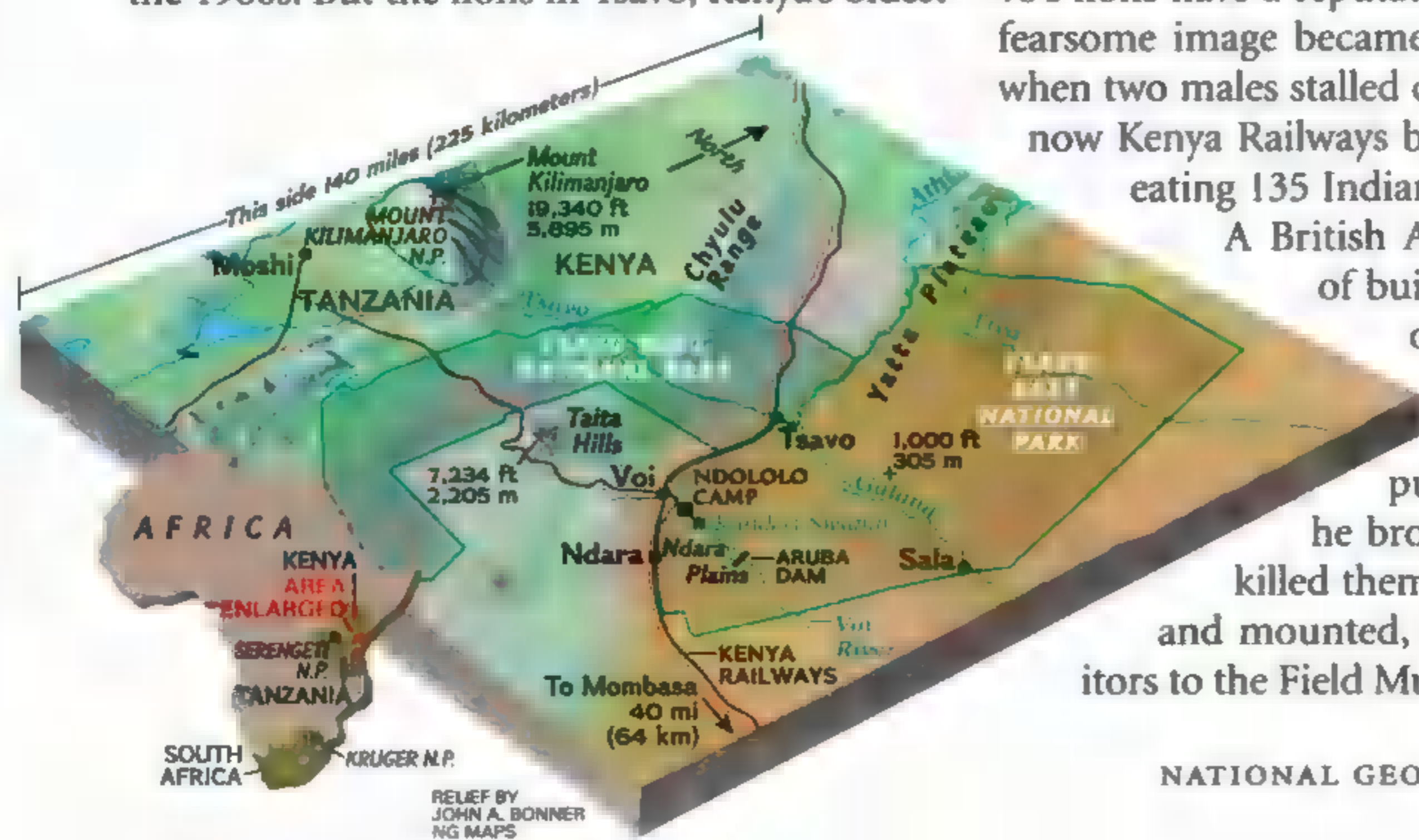
the riddle from the opposite angle. Why do its lions not have manes? (Some “maneless” lions in Tsavo East do have partial manes, but they rarely attain the regal glory of the Serengeti lions.) Does environmental adaptation account for the trait? Are the lions of Tsavo, as some people believe, a distinct subspecies of their Serengeti cousins?

The Serengeti lions have been under continuous observation for more than 35 years, beginning with George Schaller’s pioneering work in the 1960s. But the lions in Tsavo, Kenya’s oldest

and largest protected ecosystem, have hardly been studied. (Tsavo’s nearly as big as Massachusetts at more than 8,000 square miles, ranging from an arid eastern half to green western hills that look out toward the ice-crowned peak of Mount Kilimanjaro, 75 miles away.) Consequently, legends have grown up around them. Not only do they *look* different, according to the myths, they *behave* differently, displaying greater cunning and aggressiveness. “Remember too,” *Kenya: The Rough Guide* warns, “Tsavo’s lions have a reputation for ferocity.” Their fearsome image became well-known in 1898, when two males stalled construction of what is now Kenya Railways by allegedly killing and eating 135 Indian and African laborers.


A British Army officer in charge of building a railroad bridge over the Tsavo River, Lt.

Col. J. H. Patterson, spent nine months pursuing the pair before he brought them to bay and killed them (see page 51). Stuffed and mounted, they now glare at visitors to the Field Museum in Chicago.







**Lions play-fight (above left) and groom away flies and burrs (above) in Tsavo East, more arid and game-poor than Tsavo West (map). “These males are likely stressed—from heat and from struggling to eat in marginal habitat,” says biologist Peyton West. “This could  mane loss or simply prevent mane growth.” Lion research in the cooler, greener Tsavo West is lacking, but, she says, “I’d expect to see more full manes in that better habitat.”**

Patterson’s account of the leonine reign of terror, *The Man-Eaters of Tsavo*, was an international best-seller when published in 1907. Still in print, the book has made Tsavo’s lions notorious. That annoys some scientists.

“People don’t want to give up on mythology,” Dennis King told me one day. The zoologist has been working in Tsavo off and on for four years. “I am so sick of this man-eater business. Patterson made a helluva lot of money off that story, but Tsavo’s lions are no more likely to turn man-eater than lions from elsewhere.”

But tales of their savagery and wiliness don’t all come from sensationalist authors looking to

make a buck. Tsavo lions are generally larger than lions elsewhere, enabling them to take down the predominant prey animal in Tsavo, the Cape buffalo, one of the strongest, most aggressive animals on Earth. The buffalo don’t give up easily: They often kill or severely injure an attacking lion, and a wounded lion might be more likely to turn to cattle and humans for food.

And other prey is less abundant in Tsavo than in other traditional lion haunts. A hungry lion is more likely to attack humans. Safari guides and Kenya Wildlife Service rangers tell of lions attacking Land Rovers, raiding camps, stalking tourists. Tsavo is a tough neighborhood, they say, and it breeds tougher lions.

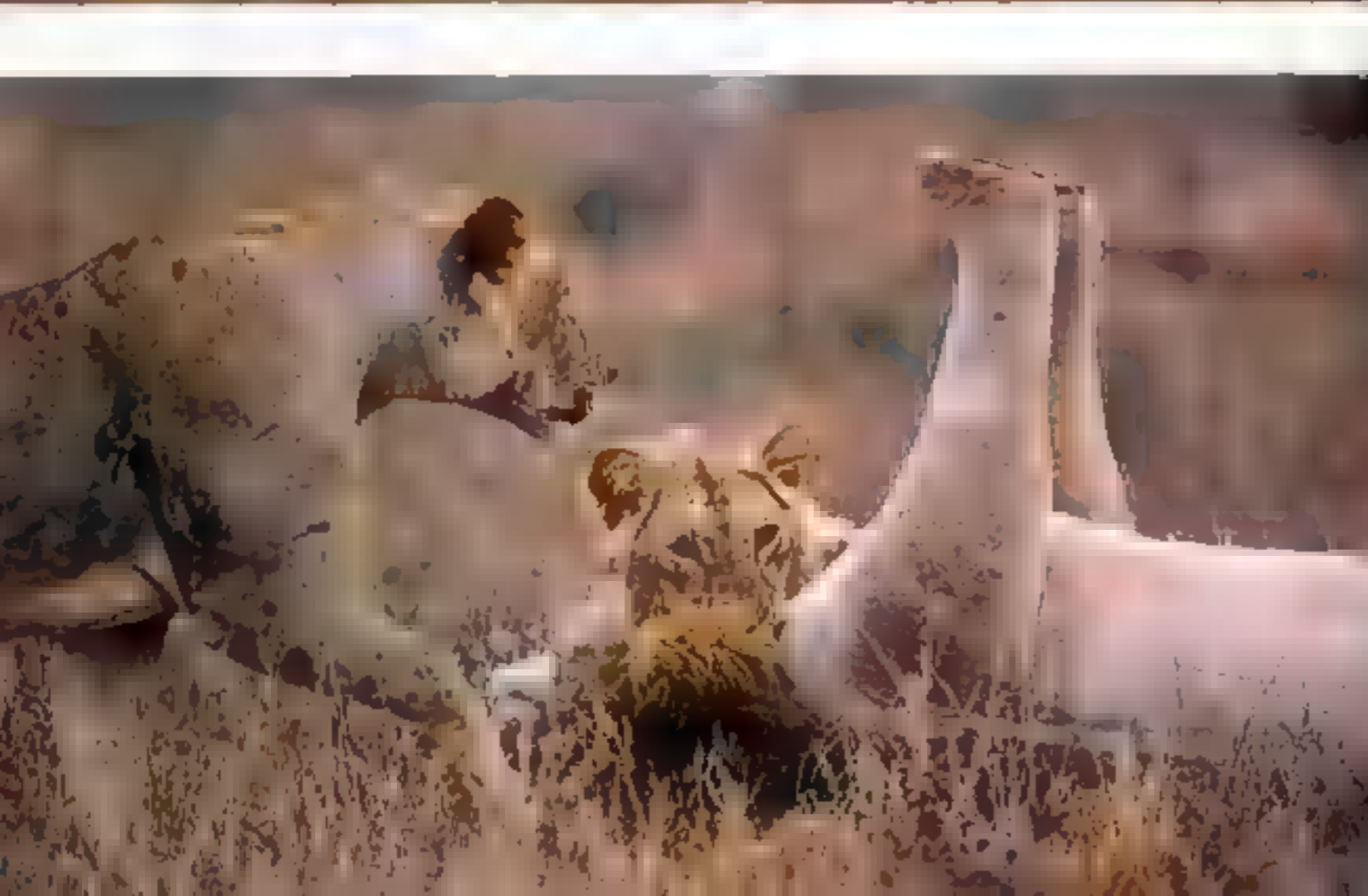
**B**ut are they really tougher? And if so, is there any connection between their manelessness and their ferocity? An intriguing hypothesis was advanced two years ago by Thomas Gnoske, a researcher from the Field Museum, and Julian Kerbis Peterhans, an associate professor at Roosevelt University: Tsavo lions may be similar to the unmaned cave lions of the Pleistocene (*Panthera spelea*). The Serengeti variety is among



## MANE EVENT

Dummies

lugged into the field by Peyton West and Craig Packer tested how real lions react to manes of differing hues. "We suspect that mane color, like size, sends a message to other lions," says West (right, with Packer and "Fabio," foreground). In the Serengeti, light manes seemed least threatening to resident lions. Results in Tsavo matched: A pair of males approached only the blond decoy—sniffed it (below), turned if to what it was looking at (center), and finally knocked it over (bottom). "Bob wanted more photos, but I revved the engine and yelled to get them off before they could do damage," says West. "I've spent enough hours sewing those dummies up."



the most evolved of the species—the latest model, so to speak—while certain morphological differences in Tsavo lions (bigger bodies, smaller skulls, and maybe even lack of a mane) suggest that they are closer to the primitive ancestor of all lions.

Craig and Peyton had serious doubts about this idea, but admitted that Tsavo lions pose a mystery to science. To tackle it, they had come equipped with an arsenal of tools: a pair of life-size dummy lions that could be dressed in manes of varying sizes and colors (to test behavior), an infrared camera that measures body heat and converts the measurements to digital images (to test levels of heat stress),





GPS (to mark locations of prides), night-vision scopes, and tape recordings of various animal calls (to summon lions from their lairs).

They brought their resources to bear on the trio Craig and I had found. Later that day, joined by Peyton, we returned to Ndara and found the three doing what lions spend most of their time doing—nothing. They lounged in the bushes, flicking at flies with their tails. We christened them Baby Huey (the largest), Meathead (whose jutting jaw gave him a stupid expression), and Fur Boy (the smallest but the owner of the most hair: sparse side-whiskers and a furry “bib”). Peyton ran an experiment using techniques developed in the Serengeti,

where she found evidence suggesting a correlation between a luxuriant mane and masculine vigor. She and Craig didn’t expect the same results with the three Ndara males, because Fur Boy’s inferior size indicated that he was the youngest, but when the recorded roar of a female lion was broadcast through a speaker mounted on the roof of Peyton’s Land Rover, Fur Boy was the first to set off toward the sound and the first to arrive at the Land Rover—where he looked for a lioness but found only a female of the wrong species.

In any event he and his companions had behaved as Serengeti lions would have in the same circumstances.





Craig exulted. "It would have taken years just by observing things as they happen naturally to see what we saw tonight in minutes." But in science as in life, pride goeth before the fall. The next experiment, four days later, failed.

In the interim we'd discovered that Baby Huey, Meathead, and Fur Boy belonged to a male coalition that included a fourth lion, which we found devouring a maggot-infested buffalo carcass with a lioness near Aruba Dam. We called him Burr Boy because of the burrs matting his scruffy side-whiskers. He was courting his female dining companion, Melinda, as a second lioness, an old one with rounded teeth, Granny, joined the group.

**O**ne day photographer Bob Caputo returned from a scouting trip and reported that he'd just spotted Burr Boy all on his own, bedded down behind the earthen dam. A solitary male provided an excellent opportunity to test how a male reacts to mane length in rival males. The dummies were recoiffed, the first with a long "wig," the other with a short one. Peyton had run this experiment seven times in Tanzania, and every time,

the live lion approached the dummy with the smaller adornment, leading her to hypothesize that another purpose of a mane is to send a message to males: The more prominent it is, the stronger is its possessor, telling potential rivals, "I'm no one to mess with."

We set up alongside the lake in the splendid light of a late East African afternoon. A hen plover and two chicks, each hardly bigger than a locust, pecked grass seed at the shore. A sacred ibis flew low over the water, a winged spear of black and white, while a pair of hippopotamuses wallowed, one giving a cavernous yawn—it looked as if you could park a Volkswagen in its jaws. In the far distance a herd of elephants proceeded at a stately pace toward the water hole. The idyllic scene was shattered when Peyton switched on her recording of hyenas on a kill. It sounded like hell's own choir accompanied by a madhouse glee club: a demoniacal medley of groans, cackles, giggles, howls, and shrieks. As unpleasant as it is to human ears, the racket hyenas make when devouring prey is an irresistible summons to lions, telling them that there is food to be had by simply driving off the hyenas.





**Cape buffalo are tough quarry, but a coalition of Tsavo males (one visible here) usually prevails. Not this day: Despite its bloody wounds, the buffalo held its ground. When successful, Tsavo lions rarely gorge on a kill, perhaps to avoid heat stress. Instead, says Packer, “they’ll gnaw for days on rotting carcasses no self-respecting Serengeti lion would touch.”**

In a few minutes Burr Boy’s head appeared above the berm. He started forward, but instead of finding a pack of hyenas and a more or less free meal, he saw what looked like two invading males. He approached with utmost care, amber eyes riveted on his adversaries, nostrils twitching to pick up a scent. An arresting sight, all that golden muscle flowing in the golden light, but I wasn’t too impressed with his intelligence. In the Land Rover with Peyton, I whispered that he ought to have figured out by now that the two creatures in front of him, scentless, motionless, and silent, were decoys.

She replied that confrontation with a rival male or males is the biggest event in a lion’s life; he can’t afford to be anything but extremely

cautious, the consequences of rash action being catastrophic: eviction from his pride, serious injury, even death. “If you were in a dark alley, and some guy pointed an authentic-looking toy pistol at you and said, ‘Give me your wallet,’ what would you do, even if you suspected the gun was fake?” she asked.

Burr Boy, now within five yards of the dummies, crept toward the one with the shorter mane, lowering his head and circling around to its side, which is something lions always do around a strange male. Facing eyeball to eyeball is sure to provoke a fight.

Craig and Peyton were satisfied. Eight times in a row, the last time here, a lone male approached the dummy with the sparsest mane, calculating that it was the lesser of two possible evils. As far as behavior went, the evidence was tipping toward a similarity, rather than a difference, between Tsavo and Serengeti lions.

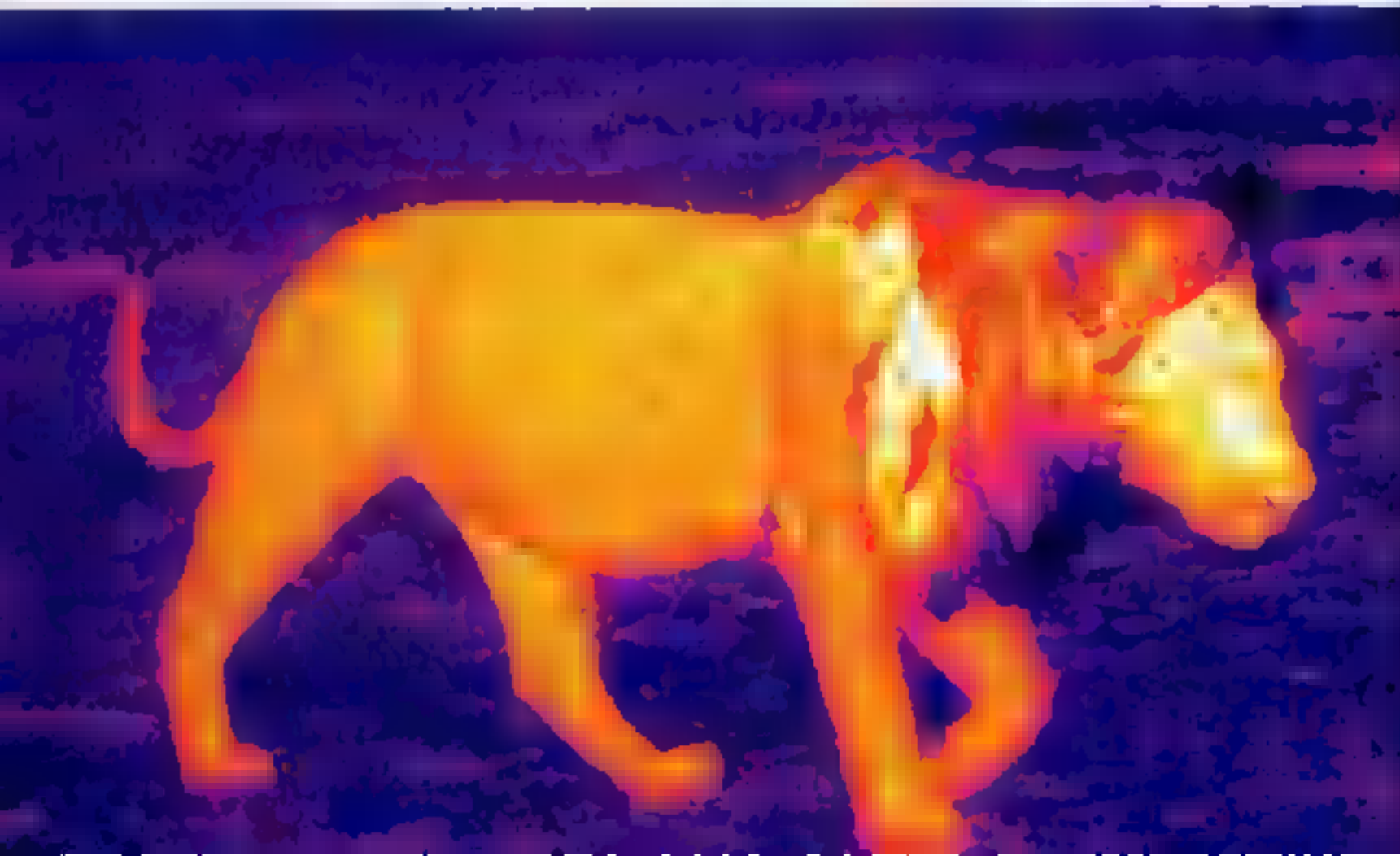
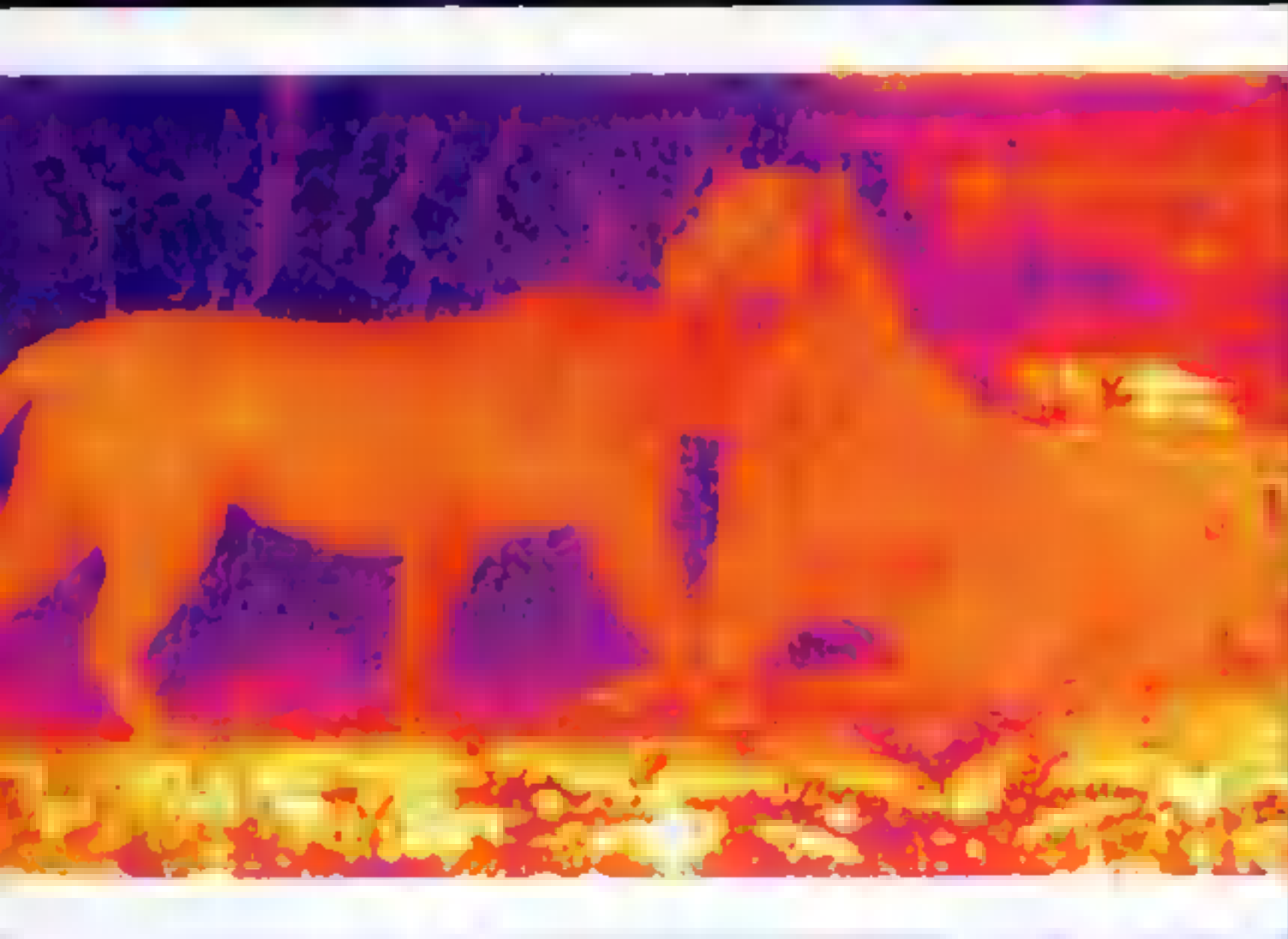
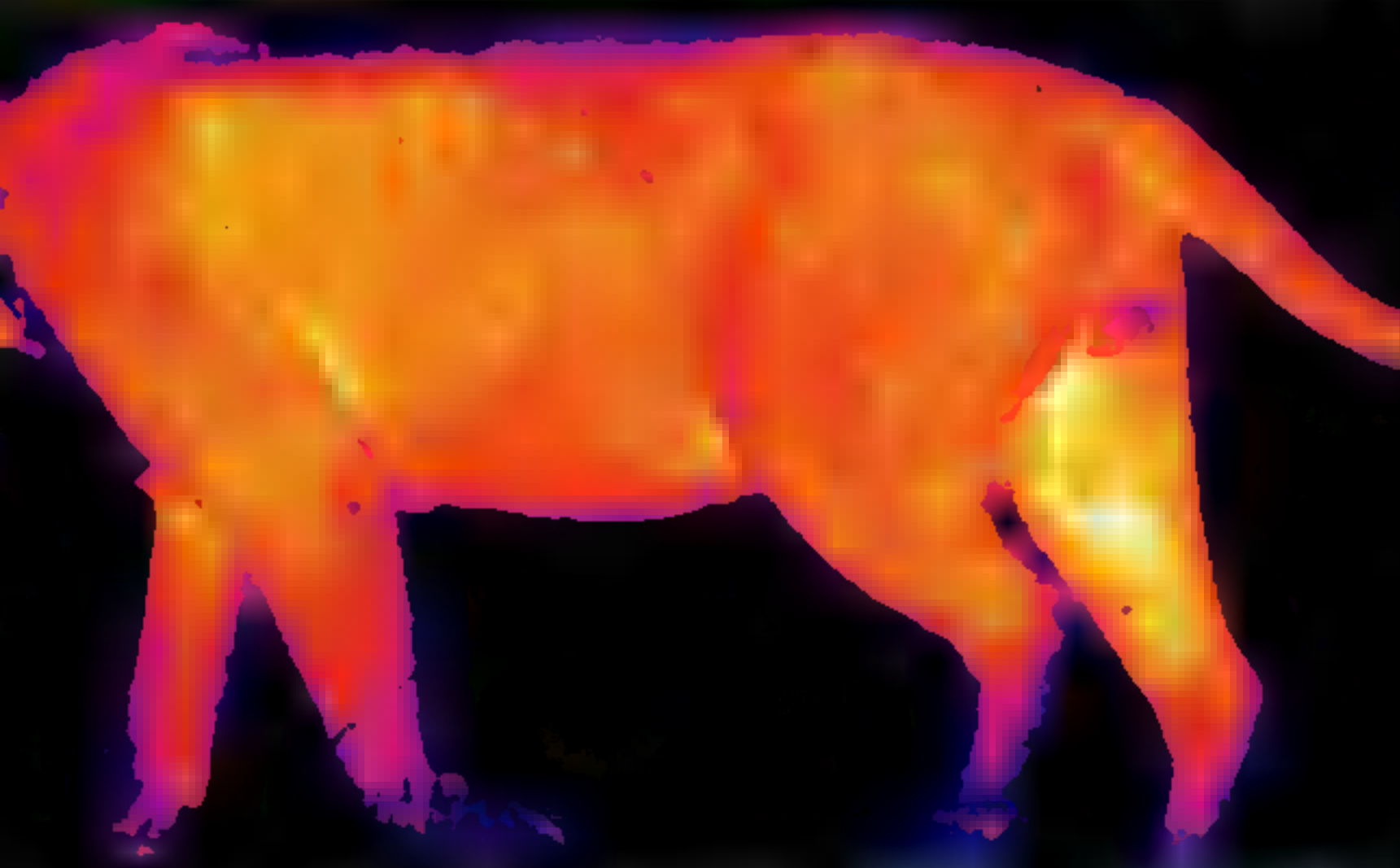
But if manes are so important, why are Tsavo lions so hairless? Peyton was working on a few ideas. Tsavo’s heat was central to one. Noontime temperatures often approach, and sometimes exceed, one hundred degrees F. We had seen lions reacting to the heat—panting constantly,



## IN HEAT

Thermal photos reveal what's hot (white), what's cool (blue), and everything in between (yellow). A mated pair of Tsavo lions chill out just barely in the shade (center), while a Serengeti male (bottom) displays a hot spot where his ample mane insulates his neck. The maneless Tsavo male (below) keeps a cool head and, more important, cool testicles—"without which sperm production would go way down," says West. "Serengeti females prefer mates with fuller manes, but in Tsavo there's a trade-off." Fierce-faced and postcoital at right, a partly ruffed Tsavo male may have traded big hair—a badge of virility—for better heat regulation and reproductive success.

Thermal photographs: Peyton West, University of Minnesota



lying on their backs with their legs spread, like giant house cats on an August afternoon. Readings from the infrared camera in the Serengeti and Tsavo suggest that manes may raise overall body temperature: In a colder climate, males can afford a mane, but in a hot place like Tsavo, their health might be seriously compromised. Peyton speculates that because much of the Tsavo lions' lives is devoted to keeping cool, a mane would be a costly burden. The Serengeti is higher and cooler than Tsavo, so the males there can develop their distinctive ornamentation without paying too high a price.

Perhaps the lions of Tsavo are genetically different. But the surest way to determine





genetic influences is impractical for now: capturing a male cub from Kruger National Park in South Africa, another from the Serengeti, and a third from Tsavo and raising them in identical conditions. If all grew manes at roughly the same rate, then we could say that Tsavo's environment explains manelessness. If not, then we would have a good indicator of significant genetic variation.

For now Peyton wanted to make further studies of males with the infrared camera. We had located a large pride not far from camp, near a place called Ndololo, but we'd seen only lionesses, cubs, and juveniles. The pride had to be accompanied by at least one or two adult

males, and she went in search of them one morning, with me tagging along.

I had found lion research to be much less exciting than I'd expected—hours and hours of boredom punctuated by moments of sheer boredom, waiting for the lazy beasts to do something. I was shortly to learn that the work can be otherwise.

We bounced along a rutted track bordering the Kanderi Swamp and the Voi River, hornbills flying past with plaintive cries. We found a place where the undergrowth thinned, affording us a good view. Peyton played the hyena tape, and as the hideous wails echoed across the landscape, we scanned with binoculars.





Iba zhin propped  
up to keep cool,  
a scar-faced male  
grabs a catnap.



"Oh my God!" Peyton said suddenly. In the same instant came the shrill trumpets of elephants angered by the hyena cries. Turning to look, I saw nine of them, charging out of the scrub to our right: three calves and two adolescents behind a phalanx of four females, coming on at a stiff-legged run, gray hides reddened by Tsavo's lateritic dust, ears flapping like unsheeted sails in a gale, trunks raised, tusks glinting in the early light.

They were a hundred yards away at most, a distance they halved in about two seconds, which was when the matriarch ceased trumpeting and lowered her head—a signal that the threat displays were over. This was the real thing. She came straight for us with a terrible singleness of purpose. Her tusks could easily pierce the Land Rover's thin aluminum skin, and with a little help from her friends she could overturn the vehicle and leave it looking like a flattened beer can, with us inside looking like—well, I didn't care to think about *that*. With admirable

sangfroid, Peyton switched off the tape recorder, started the engine, and took off as fast as the road would allow, meaning not very fast. We hadn't gone far by the time the matriarch, followed by the rest, thundered through the spot where we'd been parked. Eight of the elephants carried on, but the old girl, with astonishing agility, turned abruptly and chased us down the road, like a traffic cop pursuing a speeder.

Peyton stepped on the gas. Finally, satisfied that we'd been seen off, the matriarch halted and, with a parting trumpet and final toss of her great head, turned back to rejoin the others. We watched the herd shamble off, now as calm as they'd been enraged—a magisterial procession against an eastern sky going from bright orange to peach to primrose.

We doubled back to see if the hyena calls had stirred any lions. I doubted we were going to see a one; if they had been drawn in by the calls, the elephant charge would have scared them off. Then I yelled, "Stop!" There on the riverbank,

## MAN-EATERS?

In 1898 two male Tsavo lions made meals of a reputed 135 laborers, stopping construction of what is now Kenya Railways in its tracks. Lt. Col. J. H. Patterson finally "bagged the brutes" by rifle fire. "The prize was indeed one to be proud of," wrote the Brit, below with his first kill. Why the taste for humans? Perhaps because rinderpest, a disease brought by European settlers' cattle, had killed most of the lions' natural prey. In the rare attack on a human today, the culprit lion is often old or injured—lacking the stamina to take on a buffalo.

THE FIELD MUSEUM, CHICAGO





posed as if for a family portrait, was the Ndololo pride. We counted 11 altogether, but once again, all lionesses, cubs, and subadults. Peyton turned off road and eased toward them. They were not "tourist" lions, accustomed to people in motor vehicles, and nervously drifted away, across the dry riverbed. It was steep-sided, 20 to 30 feet deep. We drove slowly along our side, looking for drift so we could cross and follow the pride.

"Look! The males!"

Peyton pointed ahead. Two of them lay in the grass, both maned—sparsely, but maned nonetheless, the one black, the other blond. Peyton was counting the spots on their muzzles (each lion possesses a unique number and pattern of muzzle spots, a kind of leonine fingerprint) when they rose and padded away. They were by far the best looking males we'd seen so far, with sleek, tawny-gray coats, deep chests, and shoulders striated with muscle. They went across the riverbed, into the deep scrub beyond. We trailed them to the other side, but another surly elephant drove us off and sent the entire pride into hiding. Time to call it a morning.

Three days later Craig and Peyton spotted the Ndololo pair again and tracked them a long way before losing them less than a mile from camp. The striking lions deserved better than the condescending nicknames we'd given the others, so we called them Othello and Prince Hal. The scientists decided on another experiment with the dummies, by dressing one with a black wig, the second with a blond. Peyton's work in the Serengeti had shown that when threatened by two invaders with dark and light manes, lions choose to attack the latter, which suggests that a dark mane is a sign of strength, light a sign of weakness.

Two hours before dusk the dummies were placed side by side, with 20-odd feet separating them. A female lion's roar blasted through the speaker on Craig and Peyton's vehicle. As daylight faded, Othello and Prince Hal appeared, stalking up from behind us.

Every movement was sure and purposeful as they approached in a rippling of sinew and muscle. They slipped through the underbrush with barely a rustle, disappearing, reappearing, disappearing again.

They circled around and crept toward the invaders, Othello leading the way. Suddenly he let out a throaty cough, then a rising, resonant

History's manslayer  
is now science's  
ecological enigma.  
"The Tsavo lion  
lives on the edge,"  
says Packer, "but  
still it manages to  
thrive."

roar, followed by a series of grunts in diminuendo. *Wauugh-aaraRRRAR-UNH-unh-unh-unh*. As his fell off, Prince Hal sounded his call, and Othello moved forward. The stars and a quarter moon came out, and if it had not been for their light, we would not have seen Othello make the decisive move. With Prince Hal backing him up, he skirted around to the light-maned dummy's side, then gave it a good sniff. On the radio Craig told us to switch on our headlights, because otherwise his expensive decoy would soon be torn to bits.





We did as we were told, and the lions ran off into the elephant grass. But by approaching the light-maned dummy first, the lions had supported Peyton and Craig's earlier observations. They could not have been more delighted.

Craig had to return to Tanzania the next morning, taking with him the new information the expedition had gleaned about Tsavo's maneless lions. Many mysteries remain: Before he left, Craig told me it would take several more years of research to bring the lions of Tsavo out of the shadows of legend and into the light of

scientific knowledge. I'm not entirely sure that will be a good thing. I'm one of those people Dennis King doesn't care for, reluctant to surrender the myth.

I cling to the image of Othello and Prince Hal, roaring in the African night, beautiful in some terrible way, incarnations of all that's left in our world of the wild and the unknown. □

**ON OUR WEBSITE**

Sneak up on maneless lions and the scientists studying them at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204).

AOL Keyword: NatGeoMag



# YUCA

## MYSTERIOUS



**UXMAL** The distant Temple of the Warriors and the vast House of the Governor—both names given in modern times—dominate the skyline of Uxmal, by far the most famous of



# TAN'S

## HILL CITIES



*the ancient Mayan cities of Yucatán's hill country. The ruins of limestone that have  
fallen this into a dark, undulating landscape.*





**KABAH** A wall of identical stone masks—each part of the rain god's job with  
circular mouth and diamond-shaped nose, many of the noses broken—top of the frieze of





one of the finest of buildings at the ruins of Kabah. The colored quartzite masonry at top, reveals the mason's eye of masonry and stone that characterizes Puuc architecture.



**T**he trail into the ancient Maya ruins of Chac, Yucatán, winds through a low gray-green scrub forest where everything seems to have thorns. In the dry heat of March, when the land is without rain, a narrow path of dusty red soil takes me around stunted, gnarled trees and up and down stepped outcrops of gray limestone, pitted and shaped by thousands of rainy seasons. I have made many treks in the thorn forest of northwestern Yucatán during the past four decades. As an archaeologist, I know all too well that many remains of the ancient Maya still lie hidden here, much as they did in the dry season of 1841-42, when the American traveler John Lloyd Stephens arrived.

Plagued by heat, lack of water, and infestations of ticks, the Stephens party came upon marvel after marvel. At Labná they stood amazed by the facade of a lofty temple “ornamented from top to bottom and from one side to another with colossal figures and other designs in stucco . . . such as the art of no other people ever produced.” At Sayil they gazed upon the Casa Grande, the massive remains of an ornate three-tiered palace.

The area Stephens explored in those eight months is known as the Puuc (pronounced POOK), Maya for “ridge” and, by extension, “hill country.” The Puuc covers more than 2,300 square miles of rugged limestone hills and valleys in the northwestern interior of the Yucatán Peninsula (map, facing page).

Soils of this hill country rank among the richest for agriculture in the entire Maya area, yet the land is cursed with a water table that lies as much as 300 feet below the surface, reachable only by the occasional deep cave in the limestone bedrock.

Archaeologist and National Geographic grantee Michael Smyth estimates that the Puuc, from some time around A.D. 800 to about 1000, supported some 150 thriving towns and cities such as Uxmal, Kabah, and Sayil and may have held

500,000 people. To sustain such places in a world of little water, ancient engineers constructed thousands of cisterns below plazas and courtyards to catch, direct, and store rainwater.

In Puuc-style architecture, walls and vaults of meticulously carved stones form a veneer over solid, mortar-and-stone cores. The system of exterior adornment also distinguishes Puuc buildings. Vast numbers of individual sculpted stones were carefully mass-produced from local limestone by skilled carvers. These stones served as interchangeable parts for commonly used icons and were formed into great mosaics of huge god masks, undulating serpents, astronomical symbols, and other motifs. Such displays of cosmic pomp and power were as readable to the ancient Maya as today’s political posters are to us. Facades were punctuated with human-size statues of men and gods, such as the Maya deity found at Uxmal (below).

Archaeological evidence and local Maya tradition suggest that Uxmal, the largest and probably the most powerful of the Puuc cities, began to flourish around A.D. 700. A century or so later the city’s greatest ruler, Chan Chak K’ak’nal Ahaw, commissioned numerous temples and palaces, including the House of the Governor, that endure to this day and are among the most beautiful expressions of ancient architecture ever conceived.

Like its large neighbors, Uxmal centered on a “downtown” displaying elegant structures of carved and painted stone—temples, pyramids, platforms, and palatial residential quadrangles of extravagant adornment. Vegetable gardens spaced among the pole-and-thatch dwellings of the city supplemented the cornfields on its outer fringes. These, along with the cisterns, provided the basis of life for Uxmal and the other hill cities.

Some scholars believe that extended drought probably hastened the end of Uxmal and its neighbors in the hills. As Richardson Gill, who has studied the problem in some detail, notes, “Bad drought is relentless and inexorable . . . It just goes on and on and gets worse and worse until everyone is dead, no life is left, and the cities are empty and still.”



**SOCIETY GRANT**

This Research Committee project is supported by your Society membership.





**KIUIC** The elegant columned buildings of Kiuic (above) rise in the forest much as they did 1600 years ago, when American explorer John Lloyd Stephens first described them to the outside world. The Yucatán region covered by Stephens may hold some 150 ruined settlements, some connected by a network of raised roadways (cuzpuy b'hoob).



Scale varies in this perspective. Mérida to Uxmal is 43 miles (69 kilometers).  
ROADWAY MAP BY BILL HINGSON, DAVIDSON COLLEGE NATIONAL GEOGRAPHIC MAPS







■ *The archaeological site of Chac mirrors the limestone hills of the Puuc landscape, for the Maya built pyramids as imitation huits, or mountains (above). They served as lofty platforms for temples or other buildings of special political or religious significance, or as funerary monuments of kings and nobles.*

*The reconstruction of ancient fallen buildings is made easier in the Puuc area because the*

*finely cut stones often remain where they fell. Local Maya masons, as adept as their ancient counterparts, have reconstructed the lower part of the summit building and other portions of Chac's main structure. Others of the archaeological team (right), working with the collapsed walls of a room, carefully plot and number the smooth veneer stones before restoring them to their original positions.*





# BUILDING ON THE PAST



FIRST STAGE  
1400 B.C.



MIDDLE STAGE  
1300 B.C.

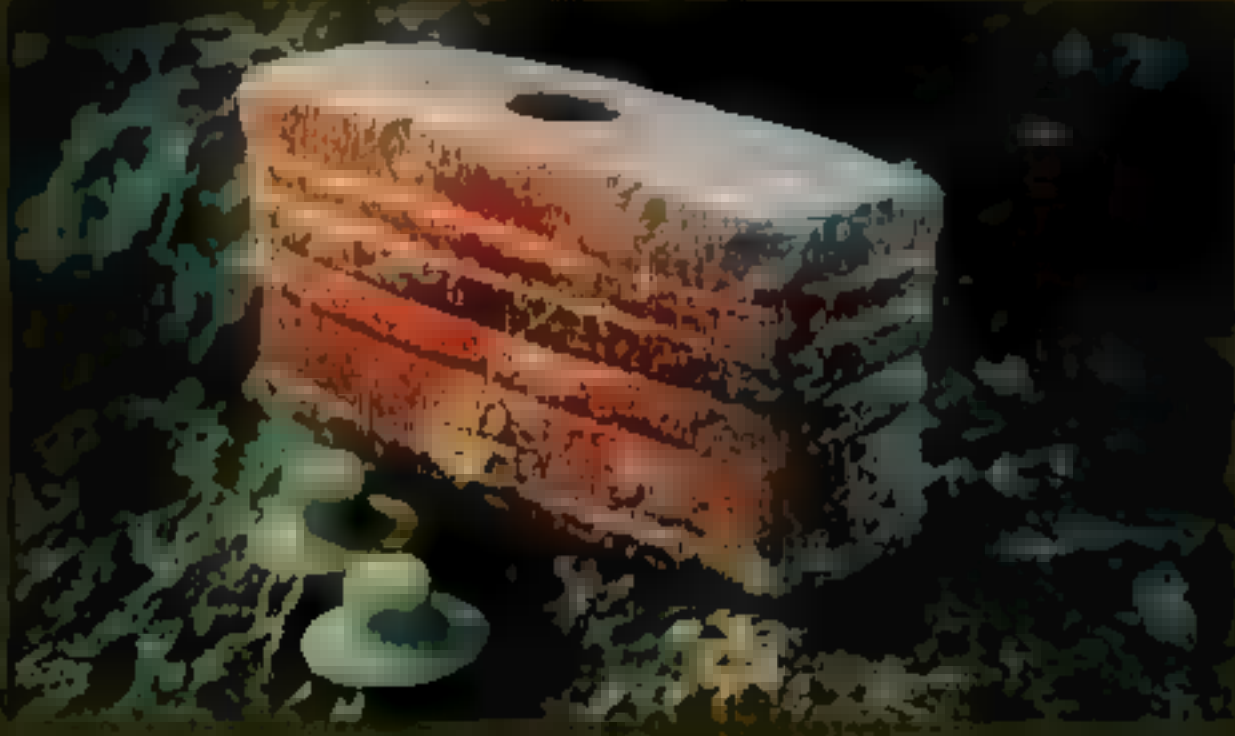


FINAL STAGE  
1250 B.C.



The pyramid was built in three stages, one on top of the other, with new construction added at each stage by the succession of a new ruler. At the top of the pyramid, three of the stages lie nested on the surface of the main pyramid. The three stages shown above. Each stage was greatly enhanced by the addition of new stone so that as the pyramid grew, it also grew in height.





AT CHAC  
CLUES TO A  
CONNECTION





Artifacts from Chac include a stone face (right) and a boxlike object and jade ear ornaments (left). The stone face resembles funerary masks found at Teotihuacan in central Mexico, and archaeologist Michael Smyth thinks the box, perhaps used for burning incense, reflects a Teotihuacan-style building facade. Smyth speculates that trade representatives from that distant city may have lived in Chac.



■ Archaeologist Michael Smyth eases down a log shield carefully placed to protect an ancient stairway. Smyth, of Rollins College in Florida, has spent seven seasons revealing the secrets of Chac. Peeling back layers of architecture in the pyramids and other buildings that surround the principal plaza, Smyth has pushed the history of the city back to the fourth century A.D.—several centuries earlier than once thought.

The new chronology strengthens Smyth's contention of a possible relationship between Chac and the grand metropolis of Teotihuacan, 500 miles to the west in central Mexico. A legend even in its own time (between about A.D. 100 and 650), Teotihuacan was the most powerful city in ancient Mesoamerica.

Additional evidence of Teotihuacan's influence comes from the style of burials that Smyth is beginning to find. Deep round holes, about three or four feet in diameter, are distinct from the rectangular burials of other Maya but resemble the style of interment at Teotihuacan. Striking similarities also exist between the size and layout of dwellings in Chac and residential apartment compounds in Teotihuacan.





**CHAC** At 8 — reduce limestone masonry to rubble. Maya pull down a temple and erect  
a wall to seal off the ruins. Eruption ends at 9 — the miracle that allows A.D. 900 to last.





CHRISTOPHER A. ...

center was purposely destroyed and its temples dismantled. Perhaps political rivalries disrupted the civilization, for at the same time a nearby ...







## GATEWAY TO THE HILLS OF OXKINTOK

...all  
Maya cities,  
in and  
and  
ideas with its  
and with  
received by  
coastal sea  
routes  
ceramics, textiles,  
and  
exotic such as  
used in a mosaic  
mask. The  
mask, an  
(right),  
elite  
tomb at





■ *Where the Puuc meets coastal plain, Oxkintok rises in a great sprawl of buildings (top) and stone monuments. Oxkintok's long and prosperous life came in large part from the coastal trade that brought goods, ideas, and people from other areas of Mesoamerica.*

*Mexican archaeologist Ricardo Velázquez*

*has spent recent years excavating Oxkintok. His work has pushed the dates of this powerful mercantile center back to at least the fourth century A.D. Like Smyth, Velázquez and others have uncovered evidence of the far-reaching influence of Teotihuacan, both in Oxkintok's architecture and in artifacts discovered at the site.*

*While Velázquez works in the far western Puuc, others of my colleagues seek answers about the ancient Maya elsewhere in the hill country: Hanns Prem at Xkipché and Pierre Becquelin and his French team at Xculoc. Tomás Gallareta, Bill Ringle, and George Bey have begun the first exploration of Kiuic since John Lloyd Stephens stood in the forest that covered its main plaza 160 years ago.*

*So much has been learned, but the quest to solve the riddles of the Yucatán's hill cities is only just beginning.*

#### ▶ **FROM CULTURE TO SCIENCE**

Archaeologists reveal more clues about early life in Mesoamerica at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204). AOL Keyword: NatGeoMag





**LABNÁ** A narrow archway, one of the masterpieces of Maya architecture, leads to a private patio—probably a sacred space that was limited to the royal family. Ruins of





Other vaulted structures like the one you find behind the arch, in a somewhat more westerly direction, toward the remaining complex of the royal palace.





NATIONAL  
GEOGRAPHIC  
RESEARCH AND  
EXPLORATION



#### GRANTEES

William Saturno, research associate at Harvard University's Peabody Museum of Archaeology and Ethnology, Cambridge, Massachusetts, and David Stuart, Bartlett Curator of Maya Hieroglyphic Inscriptions, Peabody Museum.

"This painting is among the most important finds in Maya archaeology in the past few decades." —William Saturno

Early Date of  
Wall Art Stuns Experts

# Uncovering a Maya Mural







**Buried for almost 2,000 years in Guatemala, the corn god and supplicants come to light with the discovery of the oldest known wall painting of Maya mythology.**





A looters' trench reveals to the research team (above) details of the 80-foot-high pyramid at San Bartolo, a Maya ceremonial site. Cut stones from the exterior, now overgrown by the jungle, appear at the top of the trench. A low tunnel leads

into the mural room. The looters left a map (left) showing the route of their tunnelings. They probably had hoped to find opulent tombs. However, the site was likely abandoned about A.D. 400, before the advent of artifact-rich pyramid graves.



By Tom O'Neill WRITER

Photographs by Kenneth Garrett

**A**rchaeologist William Saturno doesn't recommend this model of exploration: Run out of food and water, suffer heat exhaustion, follow in the footsteps of looters. Yet it worked for him last year in Guatemala when he chanced upon a nearly pristine Maya mural, and began to rewrite the time line for pre-Columbian art.

Working for Peabody Museum's Corpus of Maya Hieroglyphic Inscriptions Program, Saturno had set out to verify the existence of two stelae at San Bartolo in the Petén lowlands. He reached the site but found no stelae. Disappointed and feverish, he sought shade in a trench that looters had recently dug to reach an unexcavated pyramid. Ducking

into a tunnel, Saturno aimed a flashlight at the walls. "I started laughing," he recalls. "There was this Maya mural, a very rare thing. The looters had cleared off a section and left it. I felt like the luckiest man on the planet."

Funded by National Geographic, Saturno soon returned with archaeologists David Stuart and Hector Escobedo, from Guatemala's Universidad del Valle. By comparing the mural to reliefs in the same style, they dated the art to about A.D. 100, 150 years before the Maya Classic period began.

The four-foot-long mural section was found in a small room attached to a pyramid that is cocooned within the outer pyramid (below). The room was filled

#### THE PROJECT

**TIME:** June 2001

**PLACE:** San Bartolo, Guatemala

**GOAL:** Study mural and guard site

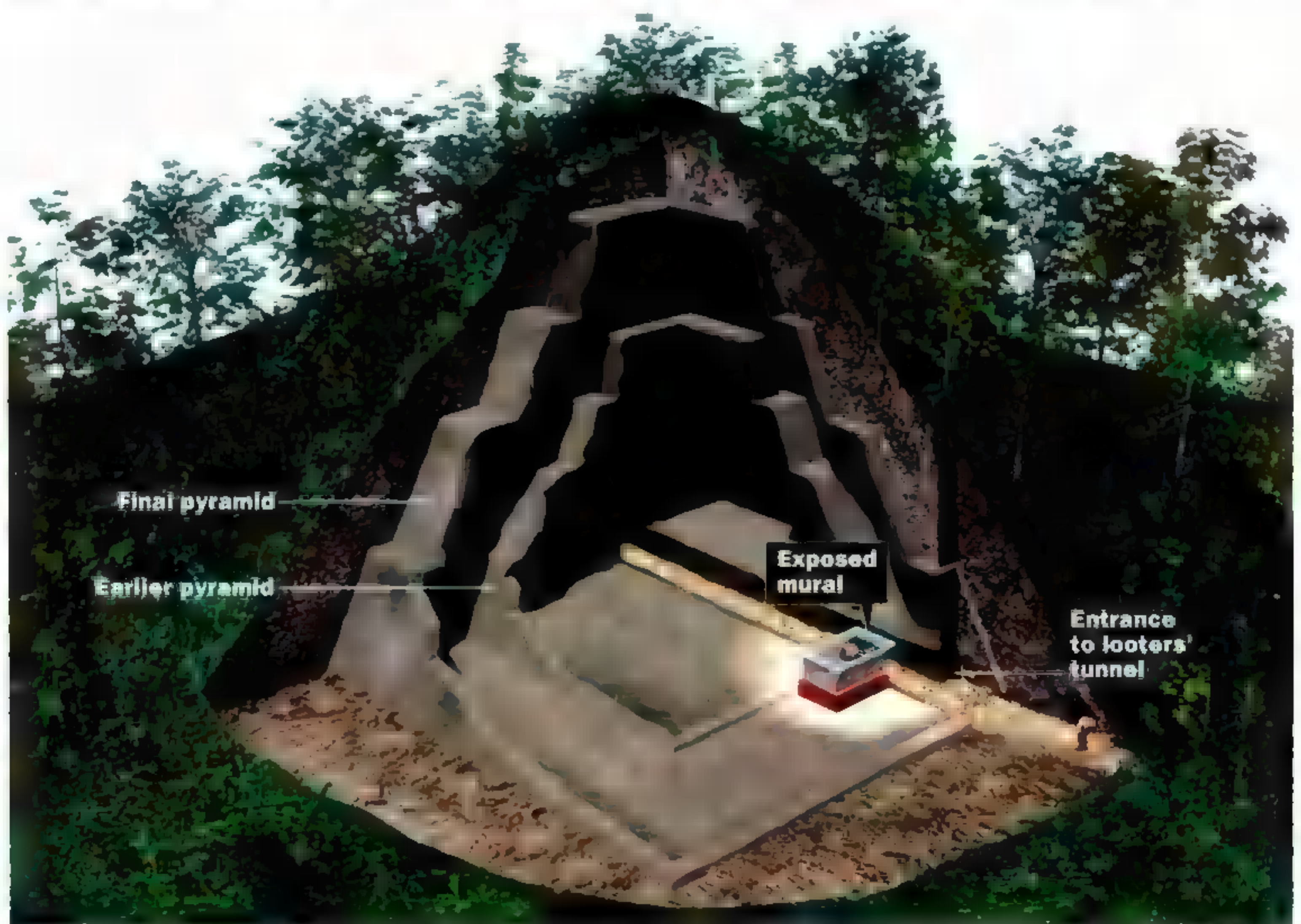
**TEMPERATURE:** 90+ degrees F

**ESSENTIAL GEAR:** GPS, digital camera, horses, tents, water, rice and beans, mosquito netting

**DANGERS:** Malarial mosquitoes, venomous snakes, and jaguars

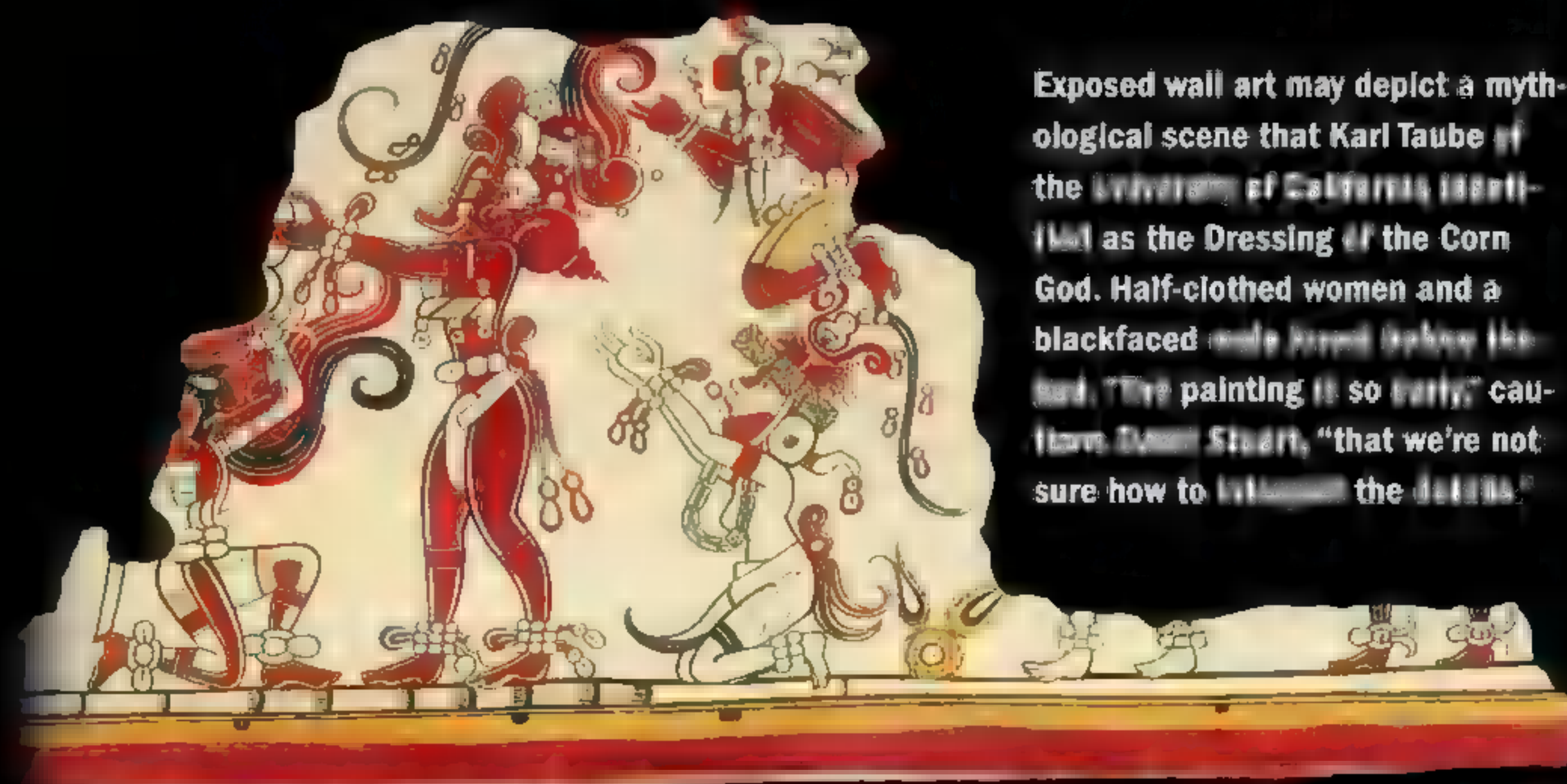
with rubble, added to support later construction, but Saturno and Stuart believe that the mural wraps around all four walls.

The crew sealed off the tunnel and posted guards. They also began considering the impact of their find. "Everything we talk about being from the Maya Classic period," Saturno said, "may have been in place much earlier than we thought."



ART BY FOLEY





Exposed wall art may depict a mythological scene that Karl Taube of the University of California identified as the Dressing of the Corn God. Half-clothed women and a blackfaced male stand before the god. "The painting is so badly caulked," cautions Dawn Sturt, "that we're not sure how to interpret the details."





**“Looters definitely saw it and cleaned off part of the mural.”**

—WILLIAM SATURNO

**T**he fragility of the mural became apparent within minutes of its discovery when a large piece was found broken off and lying on the dirt floor. Saturno repositions it on the precariously hanging wall (left). He attributes the painting's survival to a protective covering of mud applied to it by Maya before they “ceremonially killed” the room, a sacred space, when they filled it with niches. Saturno and Stuart looked for smaller fragments (below) that will go to a laboratory for analysis of the pigments and wall plaster. The meaning and significance of the painting will become clearer beginning this spring when Saturno launches a five-year project to excavate the site and conserve the art. The dimensions of the room are unknown, but Saturno guesses that the exposed panel is only 10 percent of the total painting. “Finding this early mural,” he said, “could be like discovering that Renaissance art started centuries before we thought it did.” □

**MORE ON OUR WEBSITE**

For a full listing of links and other resources, visit the [archaeology division](#), go online at [www.natgeo.com](#).

AOL Keyword: NatGeoMag





# M U S K

R E L I C T S O F T H E





# O X E N

THE FIRST TEN



ARTICLE AND PHOTOGRAPHS BY NORBERT RUIZ

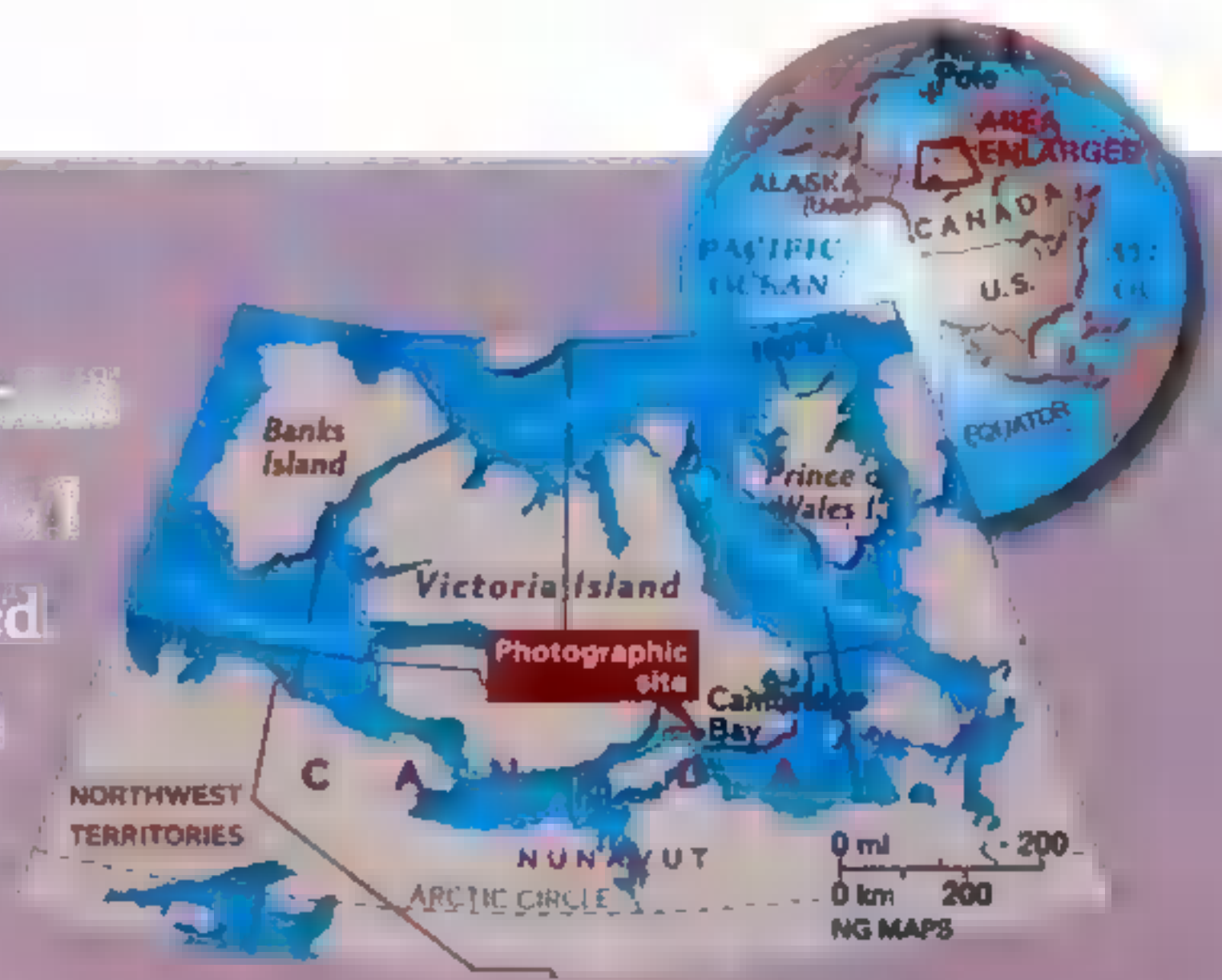
**A** drome, moose, and the muskoxen have had the remarkable luck of life but for human presence pushing a big heavy blanket of ice to eat. 17,000 years ago, an animal community that included mastodons and mammoths, waited out the ice ages of the Pleistocene 11,000 to 10,000 years ago in scattered, isolated pockets surviving Earth's many winters and climate changes that drove many animals to extinction. Yet it, too, nearly became extinct in North America a century ago, in large part because it was hunted heavily for its wool and meat, and adults were killed as calves could be captured for zoos. Conservation efforts have since brought *O. moschatus* back, and more than 60,000 now live on Canada's Victoria Island in the Arctic. Avoiding the sun's water, I spent their months over two years huddled up on the

**MORE ON OUR WEBSITE**  
▶ [Muskoxen: Hear](#)  
[musksounds](#) at [nationalgeo](#)  
[graphic.com/ngm/0204](#);  
▶ AOL Keyword: [NatGeoMag](#)






favorite mung bean soup at Cambridge Bay, 178 miles  
from the Arctic Circle. Guided by local Inuit, I  
observed and photographed these weathered  
beasts. As I'd expect, signs of the same  
competition in the distance would come  
to life. I saw up, two bulls (page 76-77)



— known to Inuit as "Inuit cow" because they stay near town and are used to  
handle—more stable, more visible faces that have changed little since their ancestors  
crossed a land bridge from Asia to North America more than 10,000 years ago.  
Crossing my energy, these muskoxen huddled close in a winter blanket that  
blocked my view and left me struggling from the wind. I recalled the 1904 adventure  
of Arctic hunter Casper Whitney, who wrote of pulling himself into his sleeping  
sack under a cover of dead dogs: "It is all in the Muskox game and so you endure."





A large, dark muskox is the central focus, partially obscured by a thick, white mist or snowfall. The animal's head and horns are visible, though the details are softened by the weather. The background is a pale, hazy landscape, suggesting a high-altitude or high-latitude environment. The overall mood is cold and atmospheric.

**IN THE THICK OF IT** Only chest high on an average human, a muskox has layers of insulation that make it appear massive. It is no wonder the Inuit call the animal *umingmak*, bearded one. This impressive bull created his own snowstorm as he shook like a wet dog—his mountainous outer coat moving like a loose wig at odds with his body. Beneath lies a soft underwool, called *qiviut*, which he sheds in summer and which local Inuit harvest and sell or make into clothing. Amazingly well adapted to cold, muskoxen can bear temperatures below minus 40°, but in the worst weather they lie down in the snow rather than stand up to icy winds.

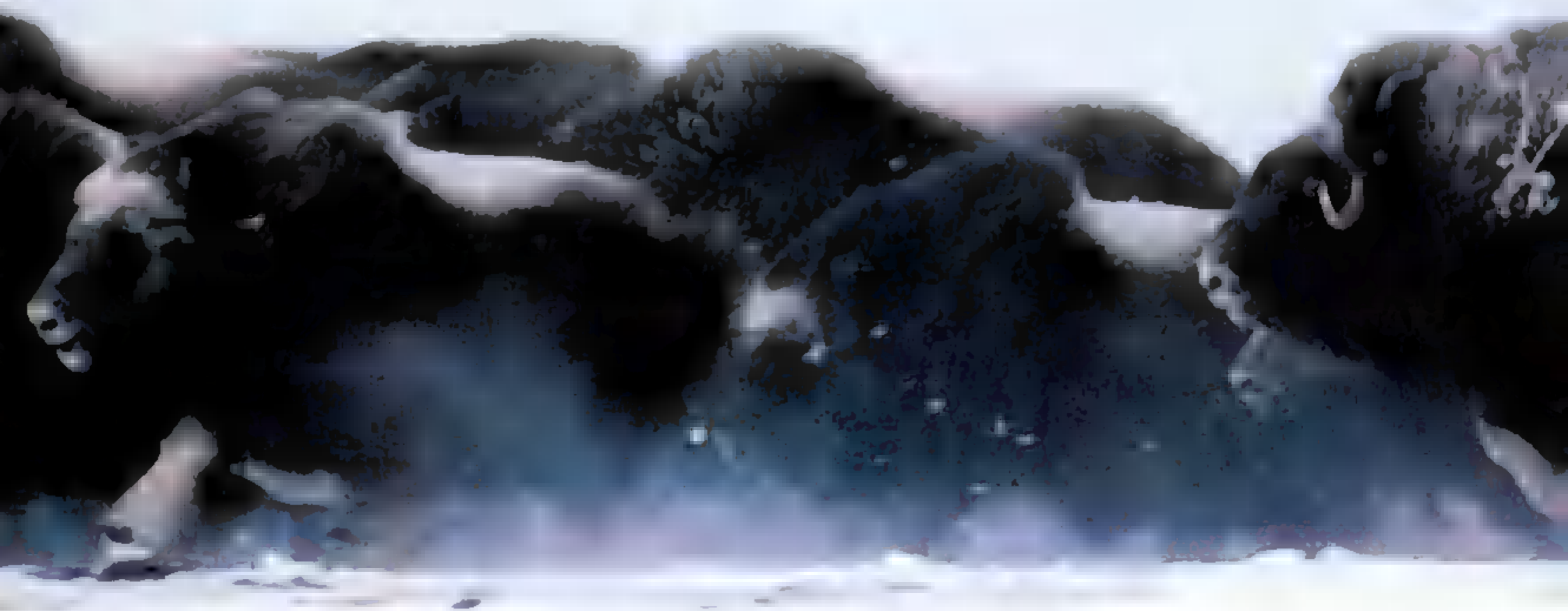
FALL COLORS IN THE ARCTIC ARE SHADES





OF WHITE- WINTHE FOLLOWS WITH A FURY.





**STRENGTH IN NUMBERS** Any perceived threat—such as a wolf or, also common around Cambridge Bay, humans on foot, on snowmobiles, or in low-flying aircraft—can set a herd off and running. It may rush headlong in a full stampede or move only a short distance before the animals back together in a defensive circle or crescent, their horns facing out. A muskox chorus line (below) couldn't know my benign intentions as I moved in as close as







*my Inuit guide deemed safe. Their impressive formation and sharp horns won't deter a hunter with a gun, but it can intimidate a four-legged predator and certainly a two-legged photographer. To protect his herd, a bull might step forward from the group, snort and scent mark by rubbing a gland below the eye against his leg, and even charge. I don't require that much warning: I backed away before causing the animals additional stress, leaving them in peace.*





# A TUNDRA'S FLEETING SUMMER MEANS



**STANDING THEIR GROUND** Scuffling head to head, rival males circle, bump bosses (the helmet of bone and horn across the forehead), and jab with horn tips in a fight for dominance. It is the rutting season, which takes place from July to October, when males battle for the right to court females and mate. Conflicts can turn more violent and noisy: Backing up 25 to 50 yards, the combatants lower their heads and charge, colliding with a crack that can be



## MELTING SNOWS AND CLASHING BULLS.



*heard a mile away. Despite sharp horns, fatal injuries from these contests are uncommon; the bulls' hard heads are built to withstand the poundings. Only the victor will get the chance to mate with females in the herd. When they become receptive in August, he'll begin heavy courtship, chasing and sniffing to determine which cows are in estrus, brushing against them and later—after a ritual of head twists and gentle foreleg kicks—mounting to mate.*





**HARSH BEGINNINGS** Skittish mothers bolt, and their days-old calves scramble to keep up (above). This group was separated from its herd but fortunately quickly rejoined it, once again safe in a crowd. Calves are born prepared for cold—with thick, curly wool coats and an internal layer of heat-generating fat—but not for independence, and if a herd is spooked into running, little ones can get left behind. Beginning as black dots on the horizon, a lost







*threesome (below left) approached us, perhaps mistaking our dark forms for their herd, then tried their luck with two wandering bulls, who ignored them. We later found the calves' carcasses in the snow, preyed on by wolves. Days before, another tiny muskox ran across a frozen lake near our camp (below) bleating like a lamb. When I observe these vulnerable youngsters' sad plights, I am reminded that humans must tread lightly on muskoxen ground.*





# IN THE LAND OF THE MIDNIGHT SUN, THE



**STILL LIGHT** *The sun lingers on the horizon flanked by sun dogs—a backdrop for a herd on a sea of snow. A million years ago muskoxen ancestors roamed Eurasia; today natural populations of their descendants grace Greenland and Canada, and introduced animals have made homes in Alaska, Russia, and parts of Scandinavia. Here on Victoria Island quotas set by biologists mean Inuit can hunt without overharvesting a precious resource. “The muskox*



## DAY'S END GLOWS WITH FIRE AND ICE.



*population is healthy and growing,” a local involved in the harvest told me. Still, a warming climate could be detrimental to these animals, causing more snow and freezing rain to bury and crust over the vegetation they eat. Future human activity might also force changes in movements and distribution, pushing the muskoxen into areas with less food or deeper snows. Yet, having spent these months with the bearded ones, I can believe they will endure.*

□





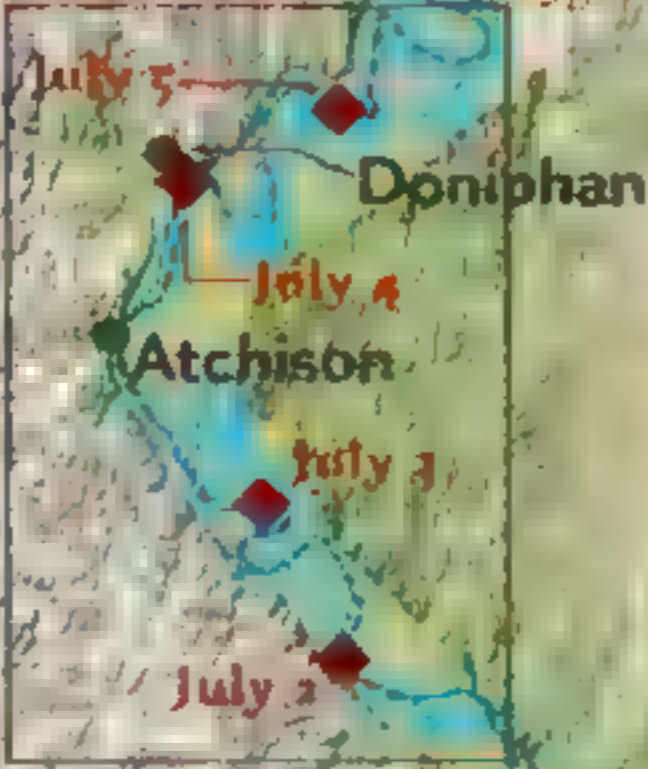
**July 14-18**  
**NISHNABOTNA RIVER**  
**AND OUT OF MISSOURI**

Few rivers noted by Lewis and Clark have changed as much as the Nishnabotna, which has lost its meandering lower reaches. It now meets the Missouri 17 miles north of the 1804 confluence. Several large islands also have disappeared. In this area the explorers encountered an ocean of grass that extended to the horizon—the Great Plains.

**July 2-5**  
**FOURTH OF JULY**  
**CREEK AND**  
**INDEPENDENCE**  
**CREEK**

Lewis and Clark celebrated the nation's 28th birthday by christening two unnamed creeks, now in Kansas. The first was Fourth of July Creek near Atchison; the second, Independence Creek near Doniphan. They fired their cannon at dawn and dusk and poured an extra glass of whiskey for their men.

**July 2-5**



**June 22-26**



**June 22-26**  
**FIRE PRAIRIE**  
**TO KANSAS RIVER**

Tormented by mosquitoes and ticks, the group pulled, pushed, and paddled its keelboat and pirogues upstream from the lush Fire Prairie to the Kansas River, seeing numerous deer along the way. Clark later described the site of present-day Kansas City as a "butifull place for a fort."







- Historical land cover**
- Forest
  - Prairie
- Historical land survey**
- Rectangular Survey System 1815-19 (Most squares represent one square mile.)
  - Survey made before 1815 (town, commons, or land grant)
- Drainage**
- Historical
  - Present-day
- Lewis and Clark campsite
  - Lewis and Clark route
- Present-day towns in black  
Names in parentheses are historical.

## THE MISSOURI THEN AND NOW

When Meriwether Lewis and William Clark pushed up the Missouri River in 1804, Big Muddy was both a portal to the unknown and a cloudy cocktail of islands, oxbows, and shifting sands that threatened to sink the expedition from the start. Before it was pretty much tamed by dikes and dams, the river bolted its course at will, obscuring the adventurers' exact route—until now. Using Lewis and Clark's field notes and journals, early land surveys, and remote-sensing data, University of Missouri geographer James Harlan brought the old river back to life, uncovering the explorers' "ghostly footprints" through the state. Some towns are loathe to give up claims to a Lewis and Clark campsite, shown as a diamond, but Harlan contends his map is as good as today's information can make it. "I just connected the dots," he says.

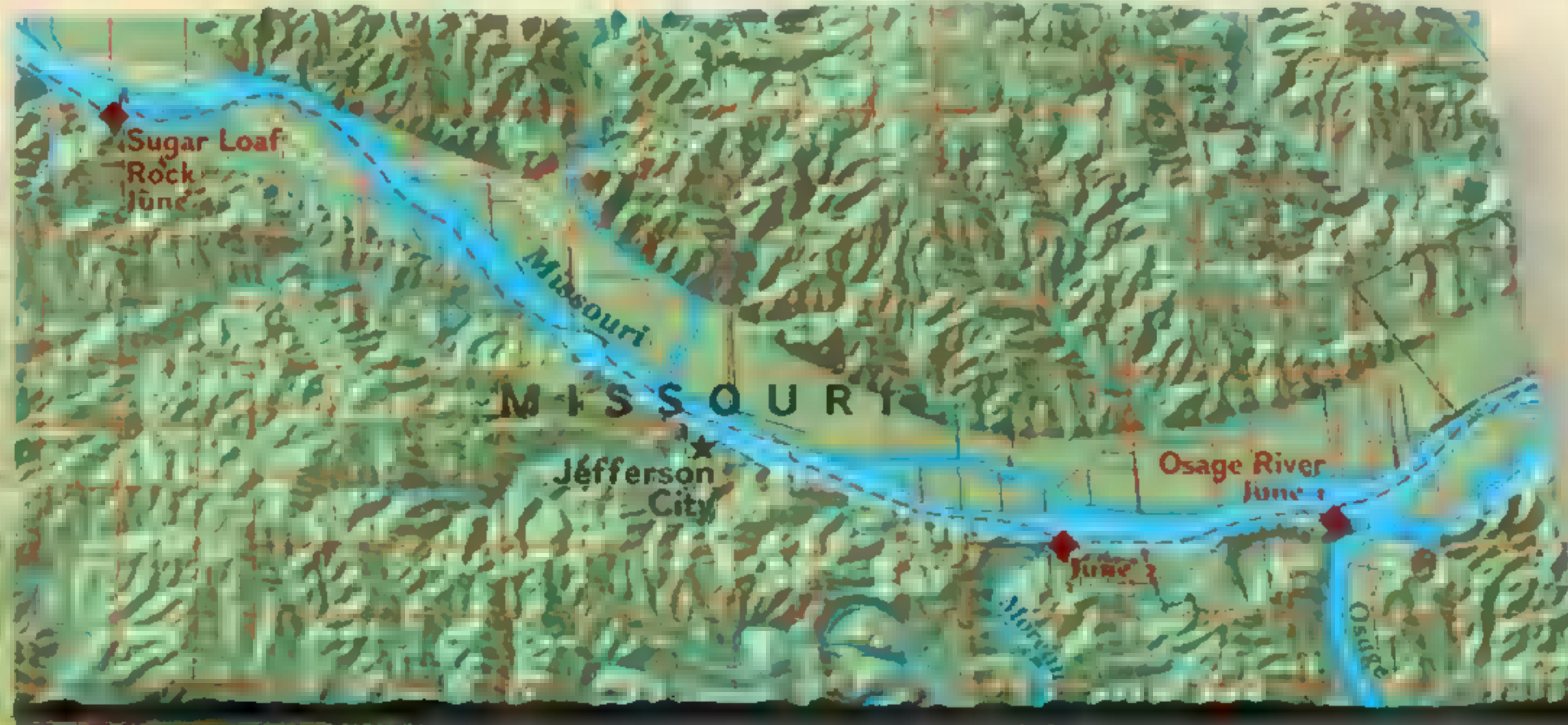


### June 10-13 CHICOT ISLAND TO GRAND RIVER

The expedition passed Chicot Island before camping on a prairie that was "roleing open & rich with plenty of water, great qts. of Deer." The residents of Glasgow, Missouri, who have long believed the explorers camped in their midst, placed a historical marker at the spot in 1966. Not so, says Harlan, who puts the June 10 camp five miles west of town.

### June 1-4 OSAGE RIVER TO SUGAR LOAF ROCK

Traveling up the Missouri, the party camped on a point at the mouth of the Osage River, where Lewis and Clark climbed a bluff to take sightings with a sextant. When Harlan climbed the bluff, he found "JCS 180\_" (the fourth digit illegible) carved in a rock, possibly by John Shields, the expedition's blacksmith.



### May 14-15 CAMP DUBOIS TO PIPER'S LANDING

The expedition embarked from its camp on the east side of the Mississippi near the Dubois, or Wood, River, across from the mouth of the Missouri. The Mississippi has since shifted at least a mile east, placing the site of Camp Dubois within the city limits of West Alton, Missouri.



0 mi 10  
0 km 10  
SOURCE: JAMES D. HARLAN, DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF MISSOURI-COLUMBIA  
NATIONAL GEOGRAPHIC MAPS



# LEWIS AND CLARK'S LOST MISSOURI



**A MAPMAKER RE-CREATES  
THE RIVER OF 1804 AND CHANGES  
THE COURSE OF HISTORY**

BY CATHY RIGGS SALTER

**JIM HARLAN** wanted to make it perfectly clear: He didn't set out to start a border dispute. "All I wanted to do was create historically accurate maps of Lewis and Clark's outward and return trips across Missouri," Harlan told me, the exasperation apparent in his voice, as we stood on a high bluff near Rocheport, Missouri, looking out over a broad

valley of the lower Missouri River. "And that's what I've done."

But Harlan's maps contain some surprises—including a visual demonstration that America's seminal voyage of exploration departed not from a site presently in Illinois, as some had thought, but from one now in Missouri.

"The expedition began from Camp Dubois, the 1803-1804 winter camp on the east side of the Mississippi near the mouth of the Wood River," Harlan said. "Back then it was in territory that became Illinois, but the Mississippi has shifted at least a mile east since that time." That means the site of Camp Dubois is now in Missouri, not Illinois. "Numerous researchers before me reached the same conclusion," Harlan said. "I just put the spot on a map."

Understandably, folks in Illinois aren't thrilled, but Richard Taylor, a historian with the Illinois Historic Preservation Agency, is philosophical. "We know they started on this side of the river," he said. "The important thing is to tell the Illinois part of the story."

When I asked Harlan what else about his maps has stirred people up, he barked, "Everyone wants to know where the explorers slept." In Glasgow, Missouri (population 1,263), for example, the citizenry has long believed the explorers spent the night on the southwest side of town, where in 1971 the state designated a Lewis and Clark historic campsite at Stump Island Park. A marker placed there in 1966 reads, "So named by Lewis and Clark on their expedition in 1804, noted in a diary as an island covered with stumps and later connected to the mainland as it now exists." Clark's journal referred to an island in the vicinity as Sheeco Island (*chicot* is French for "stump").

With the bicentennial commemoration of the 1804-06 expedition approaching, Glasgow had planned a \$300,000 riverside trail to celebrate its special connection to the explorers.

The mayor, Earl Stockhorst, also had his heart set on a big celebration for the town. Then Harlan's map of the outward journey appeared, showing that the actual island described by the explorers is about five miles west of present-day Glasgow.

On learning this unwelcome news, Earl Stockhorst initially rejected the map. He has since made peace with Harlan and, having resigned himself to geographic reality, is focusing Glasgow's bicentennial plans more on a new Lewis and Clark exhibit. "Stump Island is only one part of the story," Stockhorst said. "Harlan's map will help Glasgow tell of all the explorers who passed along our stretch of the Missouri."

**T**HE IDEA for the new maps originated with Kenneth Winn, the Missouri state archivist. In spring 2000 he asked Harlan, a geographer, if he could re-create the historical river as Lewis and Clark saw it, using their journals and the field notes of surveyors who crisscrossed Missouri Territory beginning in 1815. Winn envisioned a set of maps showing the routes west and back, details of some campsites, and physical features such as vegetation. They would be aids to the imagination in understanding the explorers' trip. "The purpose was to commemorate the journey," Winn said, "not to create problems." The main route maps, completed last summer, will be displayed at Lewis and Clark bicentennial sites across Missouri and will be available to teachers statewide.

In addition to pinpointing where the explorers camped, the maps could shed light on Native American sacred sites documented by the explorers. In his journal Clark used the word "deavel" (devil) to describe pictographs at Big Manitou Bluffs—human-like figures with antler-like protuberances on their heads.



Far from being devils, these figures represented spirits, or manitous. Long off the beaten path, such figures are now more accessible as sites of pilgrimage for Lewis and Clark enthusiasts.

Harlan believes it does a disservice to history to leave such sites in obscurity. "Finding Indian sites is not the point," he snapped. What's important, he says, is filling in the blanks of history. Unless the ancient people who invested places along the explorers' route with sacred meaning are fully represented, the story of Lewis and Clark isn't complete.

Jim Harlan's impatience with reactions he thinks are off the point belies his enthusiasm for the story itself. As a boy he spent hours scouting the countryside of central Missouri, where he developed a fascination with local history and the landscapes Lewis and Clark encountered. He recalls that when he was a

college student an excerpt from Clark's journal led him to a bluff where the explorers had found a *Den of rattle Snakes, Killed 3 proceeded on*. Harlan also found snakes there. "Lewis and Clark stumbled across those rattlers in June, when the critters were warm and ornery," he said. "I went there in the spring because I knew they wouldn't be moving much." Harlan later joined the Army and served in Panama and the gulf war. These field experiences contributed to his decision, as a civilian again, to pursue a master's degree in geography at the University

*"There is only one river with a personality, habits, dissipations, a sense of humor," wrote an early traveler on the Missouri, draped in fog near St. Louis, below. "A river that goes traveling sideways, that interferes in politics, rearranges geography and dabbles in real estate."*



SAM ABELL

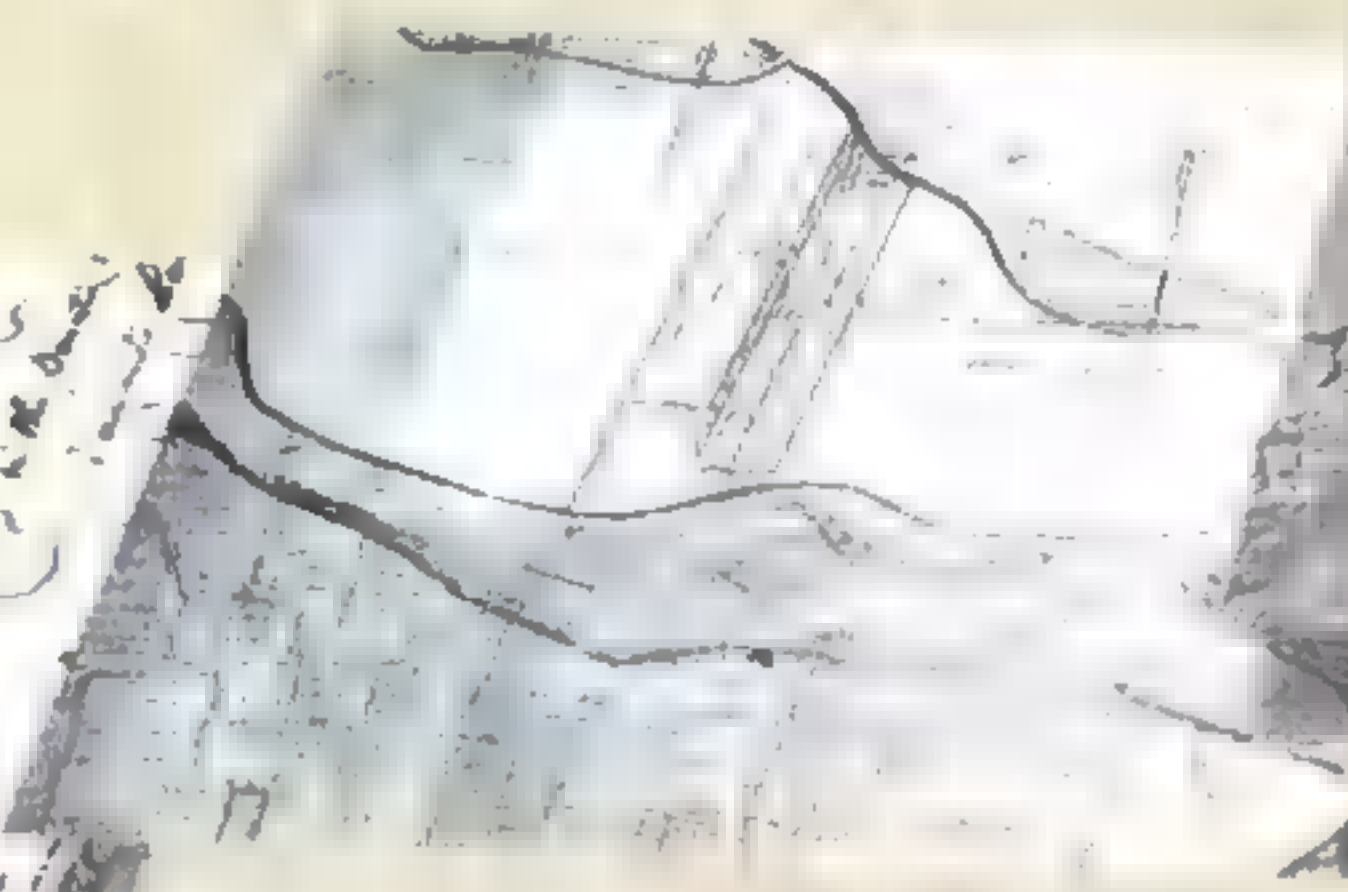
**"SET OUT FROM CAMP RIVER A[T] DUBOIS AT 4 OCLOCK P.M. AND PROCEDED UP THE MISSOURIS UNDER SAIL TO THE FIRST ISLAND . . . MADE 4 1/2 MILES. . . . CLOUDY RAINY DAY. . . . MEN IN HIGH SPIRITS."** —WILLIAM CLARK, MAY 14, 1804



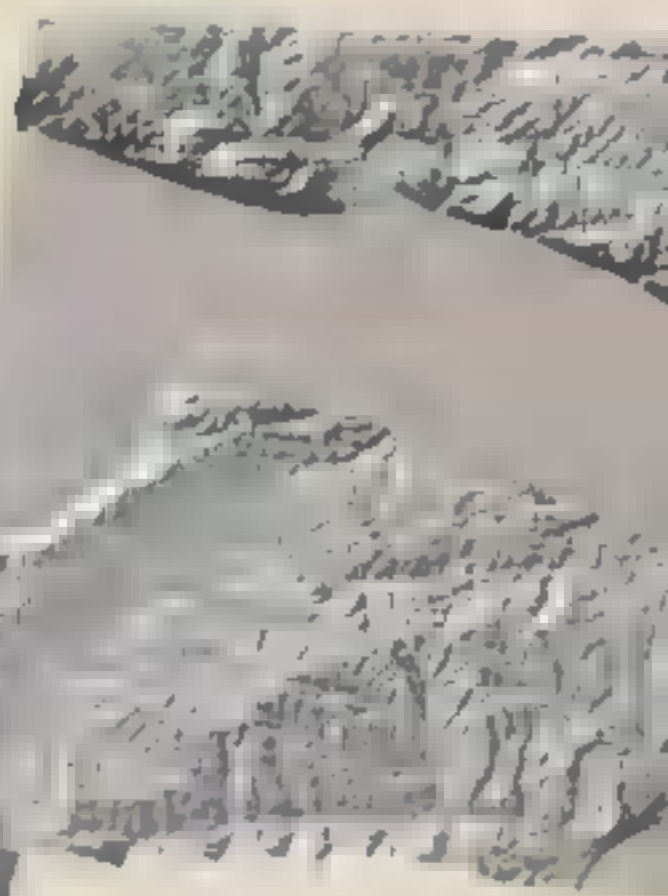
## RESURRECTING A RIVER



LEWIS AND CLARK  
SKETCH MAP



EARLY SURVEY MAP



RELIEF  
BASED ON  
DIGITAL  
ELEVATION  
MODEL

SKETCH MAP, BEINECKE LIBRARY, YALE UNIVERSITY; SURVEY MAP, MISSOURI STATE ARCHIVES; RELIEF DATA, U.S. GEOLOGICAL SURVEY; SATELLITE IMAGE, INSTITUTE FOR THE DEVELOPMENT OF COMMERCIAL REMOTE SENSING TECHNOLOGIES, UNIVERSITY OF MISSOURI; COMBINED MAP, JAMES D. HARLAN

of Missouri, because, he said, “you can’t get into history without getting into maps.”

Harlan still travels with the canvas map case that accompanied him when he was a communications chief in Desert Storm, and as we visited Lewis and Clark sites in Missouri, he struck me as equal parts skilled cartographer and field-tested soldier. I would ask a question—for instance, “How do you know exactly where Lewis and Clark began their journey?”—and reaching into the case for his map of the outward journey and a dog-eared copy of the explorers’ journals, Harlan would, with military precision, set the record straight.

He jabbed a finger at a red star on the map labeled Camp Dubois and read from Lewis’s notes referring to the start of their journey up the Missouri on May 14, 1804: “*The mouth of the River Dubois is to be considered as the point of departure.*”

“This sentence is the key,” Harlan said, explaining that because of flooding and the natural wandering of rivers, the mouth of the Dubois, or Wood, River has moved at least a mile east, as has the Mississippi itself. “My research tells me that the geographic point Lewis referred to as the mouth of the River Dubois—the point of departure—is now in St. Charles County in the town of West Alton, Missouri.

“Pick any one of the locations marked and dated on the map as a site where Lewis and Clark stopped on their outward journey,” Harlan went on, “then read their journal entries. Together, the two tell you exactly what the

explorers did that day, and what they saw along the way from that point to the next.”

He turned to Clark’s journal entry for May 14. “*Set out from Camp River a[t] Dubois at 4 o’clock P.M. and proceeded up the Missouri under Sail to the first Island in the Missouri and Camped on the upper point opposit a Creek on the South Side below a ledge of limestone rock Called Colewater.*”

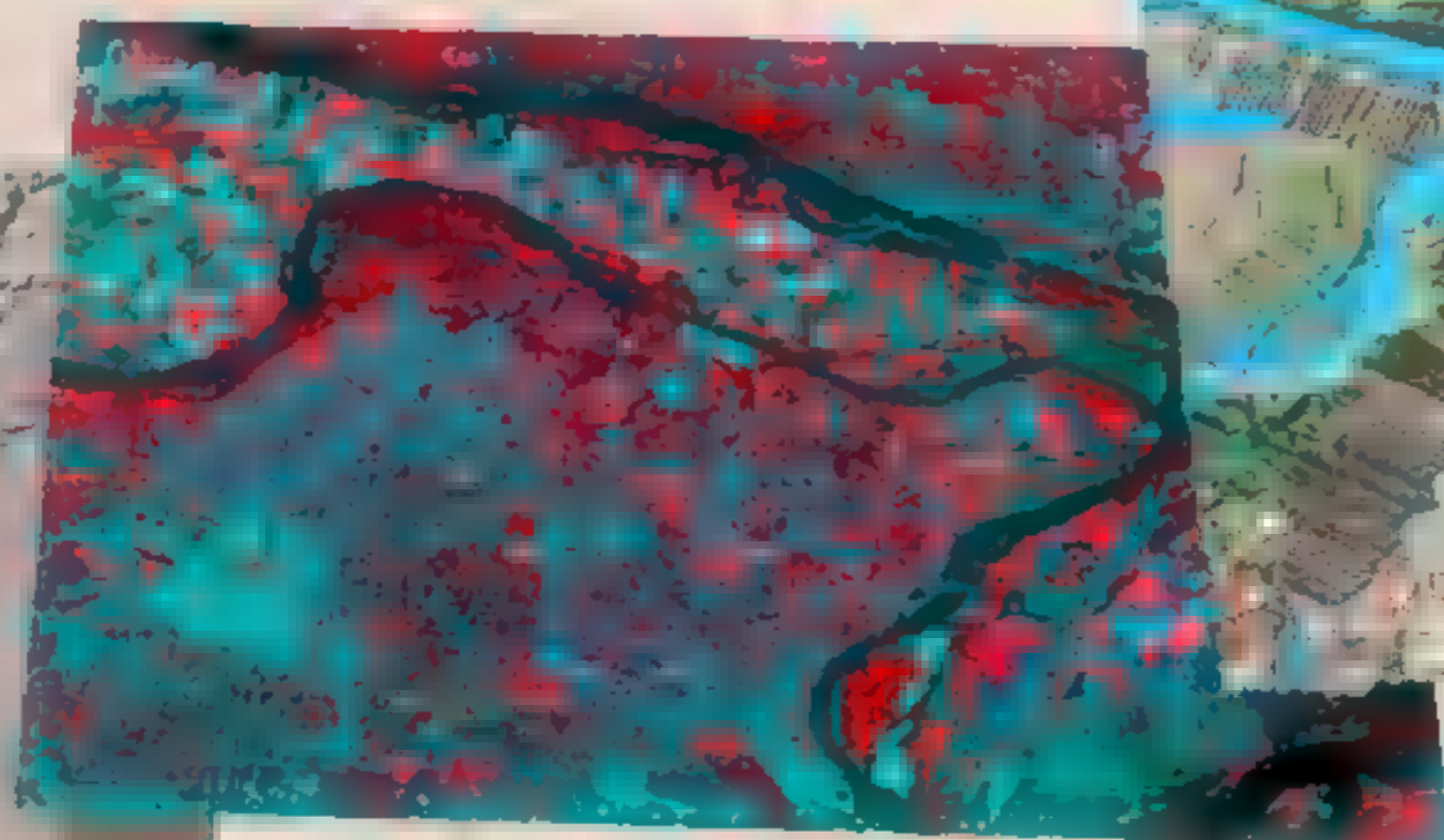
Harlan pointed to a red star marking the spot, then referred back to Clark. “. . . made 4 1/2 miles. . . Men in high Spirits.

“They’re out of that damn winter camp!” he whooped, slapping his knee. “After months of delay, they’re on their way!”

**A**S I SCRUTINIZED the map with its exquisitely detailed plotting of the river, I understood Harlan’s excitement. Combined with the explorers’ written records, it brought the story of Lewis and Clark to life. As a former teacher of both geography and history, I wished I’d had Harlan’s maps to help illuminate their journey for my students.

When on June 20, 1803, President Thomas Jefferson sent Meriwether Lewis his final instructions, he charged the leaders of the Corps of Discovery with exploring the uncharted lands up the Missouri River and on west to the Pacific Ocean. A major goal, Jefferson wrote, was to find “the most direct & practicable water communication across this continent, for the purpose of commerce.” He instructed the expedition to observe “the soil and face





SATELLITE IMAGE

Though Clark sketched maps of the Missouri, the two explorers' journal entries proved a better source for new maps of the old river. Armed with the best navigational tools they could carry, Clark, the expedition cartographer, and Lewis, who was taught to use a sextant by Thomas Jefferson himself, left a meticulous record of their daily observations, including distances between landmarks. Surveyors for the General Land Office arrived a decade later to plot townships in the



COMBINED MAP

new territory using the Rectangular Survey System, based on a plan conceived by Jefferson. They measured the location of the riverbank from 1815 to 1819. Digital elevation model data derived from topographic maps provided detailed three-dimensional relief, which was combined with land-cover information from satellite imagery to help delineate the historical riverbed. When Harlan poured all the information into a geographic information system database, the river Lewis and Clark saw emerged with startling clarity.

of the country"—keeping records and taking river measurements that would lead to the publication of an accurate and detailed map of the continent's interior.

Lewis died in 1809 before publishing a single word of the natural wonders the expedition recorded, and it was not until 1814 that Clark's map and edited journals were finally published. Though not a cartographic work in the modern sense, Clark's map conveyed a wealth of new information and further aroused in the nation a drive westward that would shape its destiny for the entire century.

The soil and face of the country have changed profoundly in two centuries. Clark described a mercurial Missouri with forested banks that heaved into the river and sandbars that shifted before your eyes. Timber cutting in the 19th century to fuel the steamboat era may have helped destabilize the banks, and by the mid-20th century the river had been leveed, straightened, channeled, and deepened.

"The Missouri of the 21st century is not the same river it was even a decade ago," said Harlan. "Disputes like the one in Glasgow ignore the fact that the Missouri, like all rivers, is evolving all the time."

**W**HILE THE NEW MAPS have challenged Glasgow's claim on Lewis and Clark, Brunswick, about 25 miles upriver, has reason to celebrate: The maps confirm that Lewis and Clark did camp there.

I drove to Brunswick—the Pecan Capital of

Missouri and the state's first officially designated Lewis and Clark campsite—and in the company of Larry Baxley, publisher of the *Brunswicker*, climbed a grassy hill. Baxley described what Clark noted in his journal on June 13, 1804. "Clark says he and Lewis walked half a mile up from their camp to the top of a hill—this hill. There they looked out over a beautiful prairie where their men later caught a raccoon and brought in a bear and a deer."

Standing in a warm breeze with one foot inadvertently resting on a dried cow pie, I nodded in agreement. It is still a beautiful prospect.

Harlan's maps locate the expedition's campsite of June 13 near the old mouth of the Grand River, where today you see a line of cottonwoods and willows—trees noted by Lewis and Clark—on the west side of Brunswick. Just east of the campsite, the town recently planted a direct descendant of a cottonwood that grew in Mandan, North Dakota, when the expedition wintered there in 1804-05.

Cottonwoods are hardy trees, enduring punishing summers and frigid winters, as the Corps of Discovery did two centuries ago. Brunswick's commemorative sapling stands as a reminder of what the explorers saw here, and Jim Harlan's maps let us see, with new eyes, the unfettered river that bore Lewis and Clark west on a voyage that defined the nation. □

**MORE ON OUR WEBSITE**

Follow our Research Division's guide to Lewis and Clark resources at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204).  
AOL Keyword: NatGeoMag





CROSSOPTILON

# China's Hengduan Mountains

**BY VIRGINIA MORELL**

**PHOTOGRAPHS BY MARK W. MOFFETT**

"ALL THE TREES AND PLANTS HERE MAKE AN UMBRELLA FOR THE BUDDHA, all the animals are his gatekeepers, and like the lakes in heaven, the waters of this holy spring can never be finished." Dongga Luzhui, an elder from a Kham Tibetan village in China's Yunnan Province, finished his recitation and bowed toward the trees that towered over us. The grove was thick and dark with ancient firs, yews,

Long before environmentalism the sacred esteem that Buddhists hold for the Hengduan Mountains helped preserve the region's wildlife. Now secular law also protects species like the white eared-pheasant (above) and the dove tree (right), whose blossoms waft in the breeze like wings.



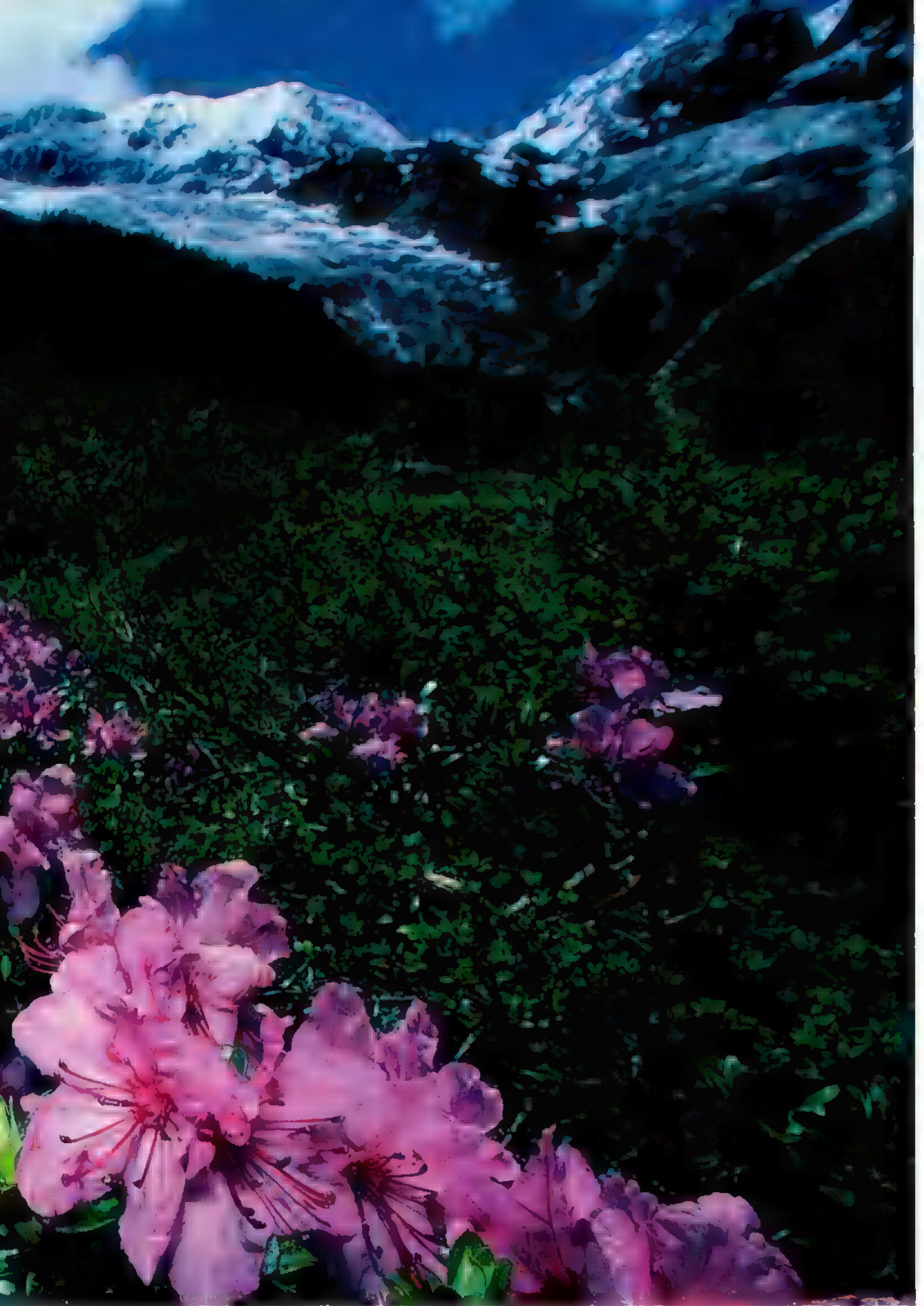






**Vivid sprays** of rhododendrons spangle Xiao Nong Valley in China's Yunnan Province. Botanists have identified 230 species of rhododendrons in the Hengduan Mountains. Early 20th-century British explorers collected these and thousands of other plants that today





**are lovingly cultivated in the gardens of England, the United States, and other countries around the world. Likened by scientists to “islands in the sky,” south-central China’s steep, isolated peaks help preserve numerous plant and animal species unique to their locales.**



hemlocks, and spruces. The trees had never been cut and never would be, Luzhui explained, because they hold the spirits of the Buddha and Living Buddhas, men believed to be reincarnations of other high holy ones.

I had joined Luzhui on a pilgrimage to a sacred waterfall in the Hengduan Mountains near Yunnan's border with Tibet. Two young Tibetan anthropologists accompanied us to document the holy sites that abound in this land of tall trees, soaring peaks, and rushing rivers. "It's not only these trees that can't be touched," said Xirao Sangbo, one of the anthropologists, "but also all the trees and animals beyond a sacred line" the local Tibetans had demarcated centuries ago. "Everything above that line belongs to the spirit of the highest mountain, and anyone who wants to take something from this forest must offer many prayers to the gods."

Such beliefs, common in the vast reaches of the Hengduan Mountains, are largely responsible for the remaining patches of old-growth forest in this part of south-central China. Running north and south, the many ranges of the Hengduans march from eastern Tibet into the provinces of Yunnan and Sichuan and cover more than 300,000 square miles. Between the ranges run four of Asia's greatest rivers: the Yangtze, Mekong, Salween, and Irrawaddy. The combination of high mountain peaks (many soar more than 15,000 feet), plunging river canyons (some as deep as 10,000 feet), and a monsoonal climate has created one of the few biological hotspots that is predominantly temperate.

Here in the Hengduans live nearly 50 species of conifers. Numerous species of maples, oaks, bamboos, rhododendrons, lilacs, primroses, and roses grow among the evergreens, forming forests that look as if they'd been planted by someone consulting a gardener's catalog. Indeed, one of the most beloved of garden plants, the elegant regal lily, was discovered less than a hundred

## H O T S P O T S

The Earth's richest and most threatened reservoirs of plant and animal life

### SOUTH-CENTRAL CHINA MOUNTAINS

**AREA** 309,000 sq. mi.

**HABITAT TYPES** Mountains, forests, savannas, wetlands, prairies

#### FLAGSHIP SPECIES

Giant and red panda, golden monkey, takin, snow leopard, white eared-pheasant

#### ENDEMIC SPECIES

3,500 plants, 75 mammals, 36 birds, 16 reptiles, 51 amphibians

#### PRINCIPAL THREATS

Logging, firewood collection, overgrazing, soil erosion, human population growth

years ago in a canyon of the Hengduans. Yet the mountains are wild, and in their deepest haunts roam some of the last remaining populations of giant pandas and red pandas, golden monkeys, snow leopards, blue sheep, and black-necked cranes.

But that rich abundance of species has been lost in most of the Hengduan ranges, primarily because of uncontrolled clear-cutting, fuelwood collecting, and hunting. Despite the sacred protection afforded to holy sites, conservationists estimate that less than 10 percent of the mountains' original forests remain. Now, however, Beijing has launched a massive effort to preserve what is left. In 1998, following devastating floods along the Yangtze River (which officials attributed to the intensive timber harvests), the Chinese govern-

ment enacted a ban on commercial logging in the Hengduan region. It also forbade hunting, created dozens of parks and reserves to attract Chinese and foreign tourists, and began promoting conservation education, often through public slogan campaigns. Through that combination of bans, tourism, and education the government hopes to turn the environmental tide in China—and ultimately preserve the country's richest region of biodiversity, the Hengduan Mountains.

"The government wants visitors to come to scenic areas and spend money," explained Bob Moseley, an ecologist with the Nature Conservancy who had joined our pilgrimage. "And the officials recognize that to attract tourists, they have to preserve the forests and biodiversity as well as the vibrant Tibetan culture."

A tall, lanky man with a mountaineer's love of vertical terrain, Moseley has spent the past year helping the Yunnan government assess the flora and fauna of the region's forests and offer ways to conserve both. Officials believe a national park to be the best solution for preserving the land and local cultural traditions. The proposed park will encompass the Tibetan village of Yubeng as well as its sacred forests, meadows, and ice-capped peaks. And







Scraping the sky, trees climb the slopes of the Hengduan Mountains above a Tibetan village in Sichuan. High-altitude forests remain mostly unexploited, partly because they are believed to be the abode of Buddhist spirits and partly because they are so inaccessible.

Twice as big as California, this south-central China hotspot harbors many peaks above 15,000 feet. Biologically it is among the world's richest and most diverse regions.







**A small mountain of firewood stands ready for winter in a village in the Hengduans. Wood collecting and clear-cutting erased more than 90 percent of the original forests, prompting a ban on logging in 1998, though taking wood for personal use is allowed. Elsewhere in the Hengduans workers plant native spruces (left) as part of a reforestation program.**

since the park will further protect these holy areas from the chain saw, the villagers view it as a good thing.

“My heart and soul are in these mountains, in these forests,” said Luzhui. “And we are glad to share their beauty with others.”

Until 1998 the villagers earned some money from small-scale logging, taking trees from the mixed conifer and deciduous woodlands below their sacred line; now they hope tourists will help make up the wages lost when logging was banned. Still, the promise of the park hasn't brought an end to all timber harvesting. Farther along the pilgrimage route we encountered a small stream-powered sawmill, where locals are permitted to shape planks for their homes.

“The villagers do occasionally use some trees above the sacred line for small projects like fences,” said Moseley. “Below it they also cut trees for fuel, something that will continue since it's the only means they have right now for heating their homes and cooking. But most of this forest appears not to have changed much over the past 75 years. It's largely intact due to the people's religious beliefs.”

To ensure that the local Tibetans' beliefs are respected in the park's plans, the anthropologists have mapped the sacred sites and recorded the stories that go with each. Their map of holy spots largely overlaps the biodiversity map that Moseley and his team of local botanists have developed from their surveys. “I guess that shouldn't be a surprise,” Moseley

said, “since many rare species are found at the higher elevations,” which is also where the Tibetans have traditionally refused to log.

Along the pilgrimage trail to the sacred waterfall, Luzhui stopped about every quarter mile to point out a holy site. One was a large boulder, where a woman from Yubeng once saw a vision of the Buddha; female pilgrims now stop to pray here, attaching offerings of prayer stones and flags, coins, and even long tresses of their own hair to the boulder and vines that cover it. At other points Luzhui pointed out particularly large fir trees. These were like brave young men or strong prayers, he said, and guided the faithful on their journey.

Near each holy site Moseley spotted some botanical treasure as well: the Yunnan *Rhodiola*, whose scalloped green leaves are used to make a tea for altitude sickness; a giant jack-in-the-pulpit with a purple-green curl unfurled like a lure for the insects that pollinate it; and groves of oak trees with leaves colored such a dark green they are almost black.

Rhododendrons bloomed in shades of red, white, pink, and yellow, their blossoms lighting up the dark woods like miniature Chinese lanterns. Some of the rhododendrons were as tall and sturdy as the oak trees, while those in the alpine meadows tidily hugged the ground—and dazzled the eye with fat clusters of electrifying purple and garnet flowers. “This area really is the center of the world's rhododendron diversity,” Moseley said, standing at the



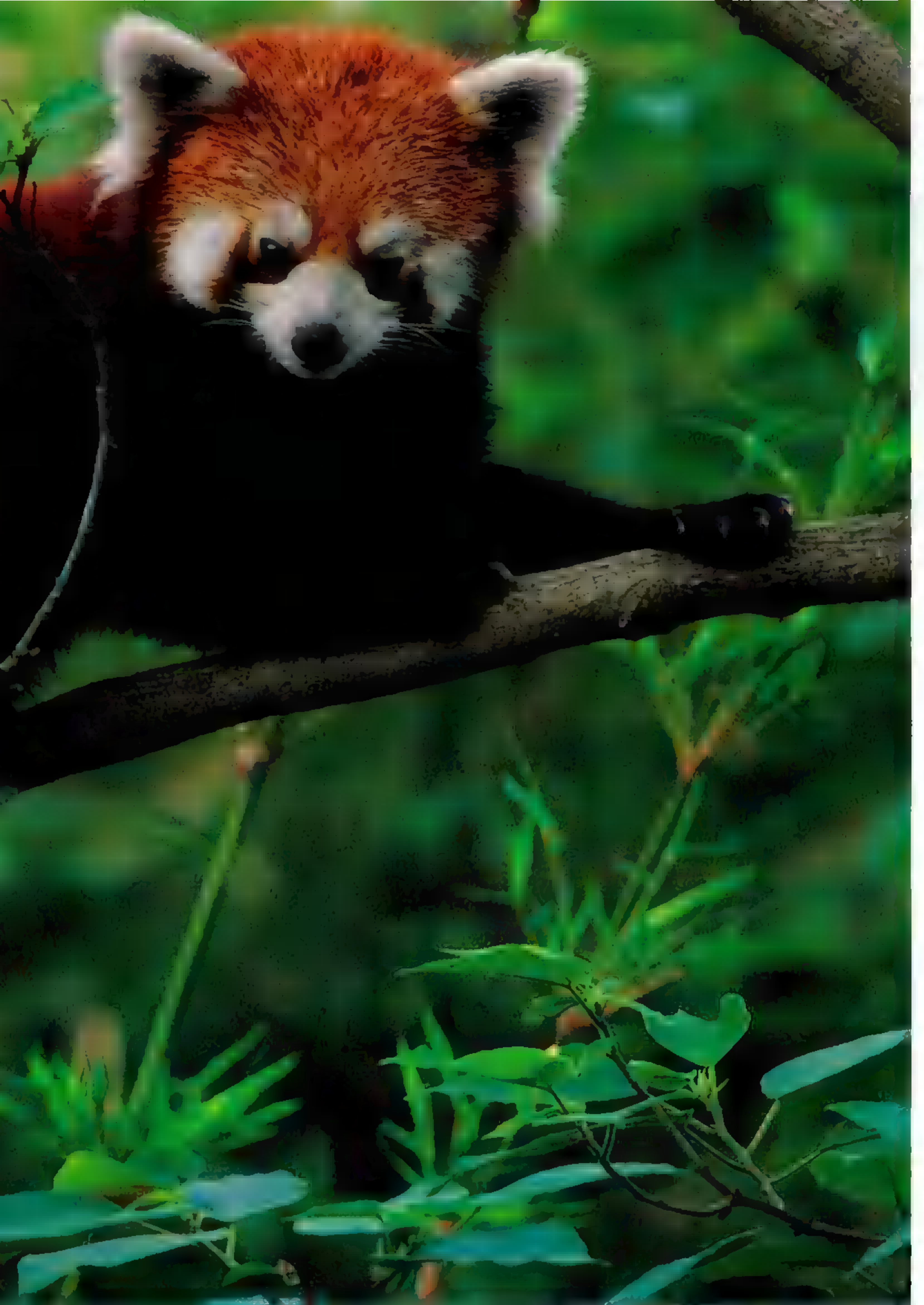






**A precarious perch** reflects the uncertain future of the endangered red, or lesser, panda, whose numbers have declined due to habitat loss and hunting for its handsome pelt. Still, the population and range of the red panda exceed those of the larger giant panda,





*Ailurop fulgens* (PHOTOGRAPHED AT CHENGDU PANDA BREEDING CENTER)

which is even more endangered. A shy and solitary animal, the red panda spends its days sleeping in trees, descending at dusk to eat. It feeds almost entirely on bamboo, with the occasional addition of other plants, insects, eggs, small birds, and rodents.





**Folk medicines** such as dried monkey blood, ground deer horn, and insects stock a pharmacy in the city of Kangding. In a Sichuan nature reserve (right) hours of tedious searching are devoted to gathering *Cordyceps sinensis*, a fungus eaten to bolster the immune system. Caterpillars hatched from moth eggs burrow into the soil, where they are invaded by fungi that sprout threads rising barely above the ground. Overharvesting is a concern since collectors may strip areas of certain species.

edge of an alpine thicket. "Altogether there are 230 species in this part of China."

It takes time for such diversity to develop. During the last ice age, some 14,000 years ago, the Hengduans had provided a refuge for many plants. "Because this region is so far south, the mountains weren't as heavily glaciated," Moseley said. "Plants and animals could retreat here," saving them from extinction and giving them more opportunities to evolve new species.

The pilgrimage path led through meadows of wildflowers and past fields of more rhododendrons. Above us the ice-and-stone peak of Mount Kawagebo rose like a saber; waterfalls plummeted from its glaciers. When we arrived at the sacred waterfall, Luzhui and the anthropologists stopped to chant and light bundles of incense cedar, letting the smoke carry their prayers to the summits of the gods. Then, fully clothed, they ran one by one through the fall's chilly waters to celebrate the creatures of earth

and sky and the bounty of Kawagebo's meadows and forests. The Tibetans' prayers had protected their land, and the land, in turn, had given them a living. Now, they hoped, the coming national park would do the same.

**A** GOOD 200 MILES EAST of Mount Kawagebo, in neighboring Sichuan Province, tour buses packed with Chinese urbanites on holiday rumbled down the highways of another part of the Hengduans. Only a few years ago logging trucks had the roads virtually to themselves, but the ban has halted that traffic. "Now it's tourists, tourists, tourists," said professor Yin Kaipu, a plant ecologist from the Chengdu Institute of Biology.

The main highway we were traveling led to one of the newest of the prime tourist spots: Mount Gongga, at 24,790 feet the highest peak in the Hengduans. Here were several





new national parks and nature reserves as well as swank five-star hotels, hot spring spas, and cable car rides. And in every nearby town and hamlet signs hailed China's new environmental era: "Return the farmland to the forest!" "Save the forest and benefit the future generations."

"It's a new way of thinking," said Yin, directing our driver to stop at a trail inside the recently opened Hailuoguo National Glacier and Forest Park. A slight man with a gentle manner, Yin has traveled throughout the Hengduans since the early 1960s, searching for new species and rediscovering others thought lost to science.

"There was a drive, starting in the 1960s, to develop this part of China," Yin explained. "At first the government thought the timber industry was good for the people here because it gave them employment and because they could grow food where the forests had been. I could see that the forests were being destroyed

and many species were going extinct, but the people were very poor, and they had to have a way to make a living."

From his explorations, most on foot, Yin knew the flora of Mount Gongga was more than unusual; it was unique, harboring species found nowhere else. So, 20 years ago, he proposed that the entire mountain be conserved. "To me, it is a treasure-house of plants," said Yin, since the vegetation ranges from subtropical orchids to alpine mosses. But the Ministry of Forestry had extensive logging operations on the mountain and at first agreed to save only the valley where Yin's colleague Liu Zhaoguang had discovered a rare plant in the lily family growing high in the branches of an oak tree.

Now guiding us up the trail into that same valley, Yin searched again for the tree-loving plant. He led the way into a forest dense with oaks, magnolias, and bamboos and carpeted with orchids and wild strawberries. Oriental



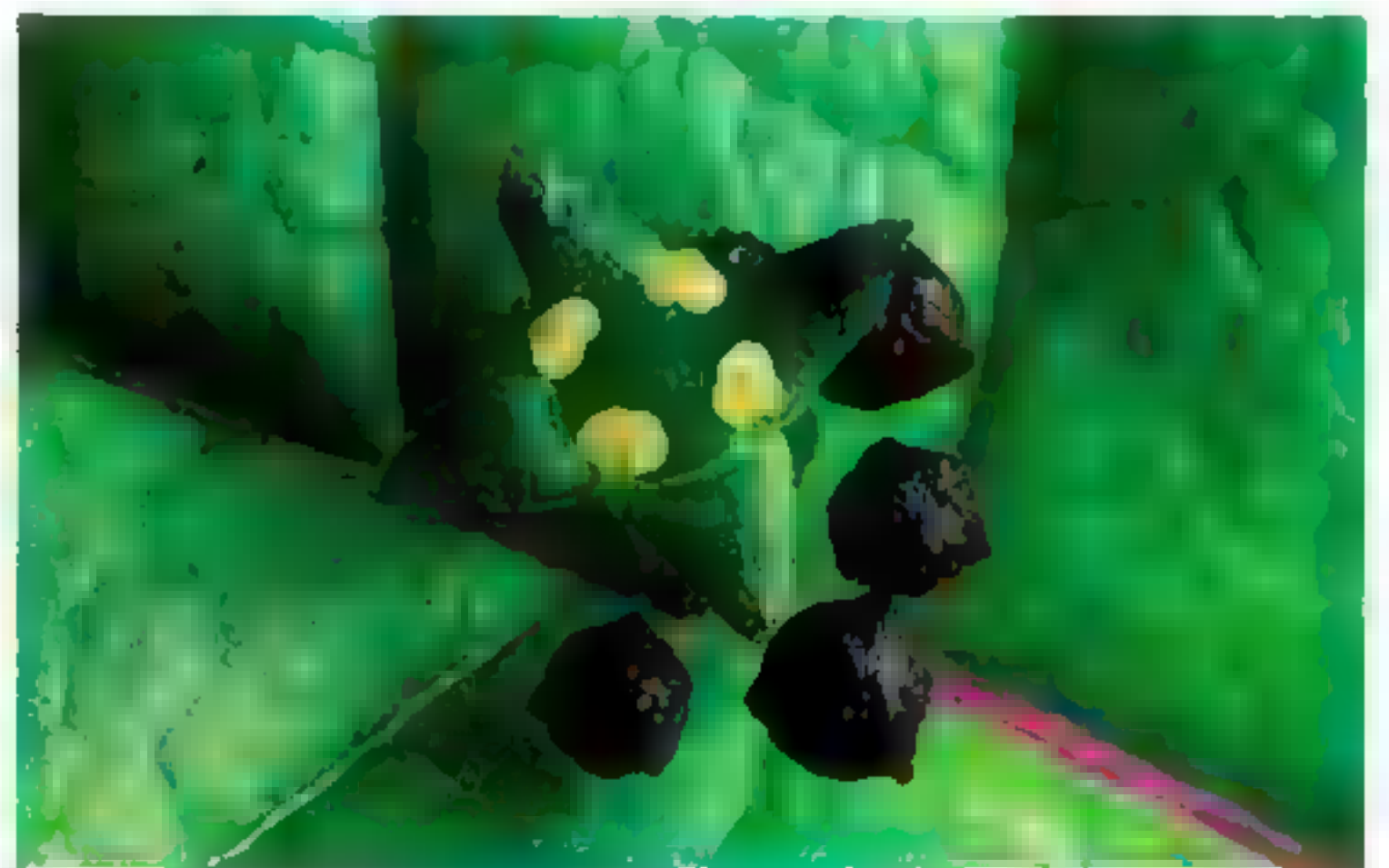


BERBERIS SP.

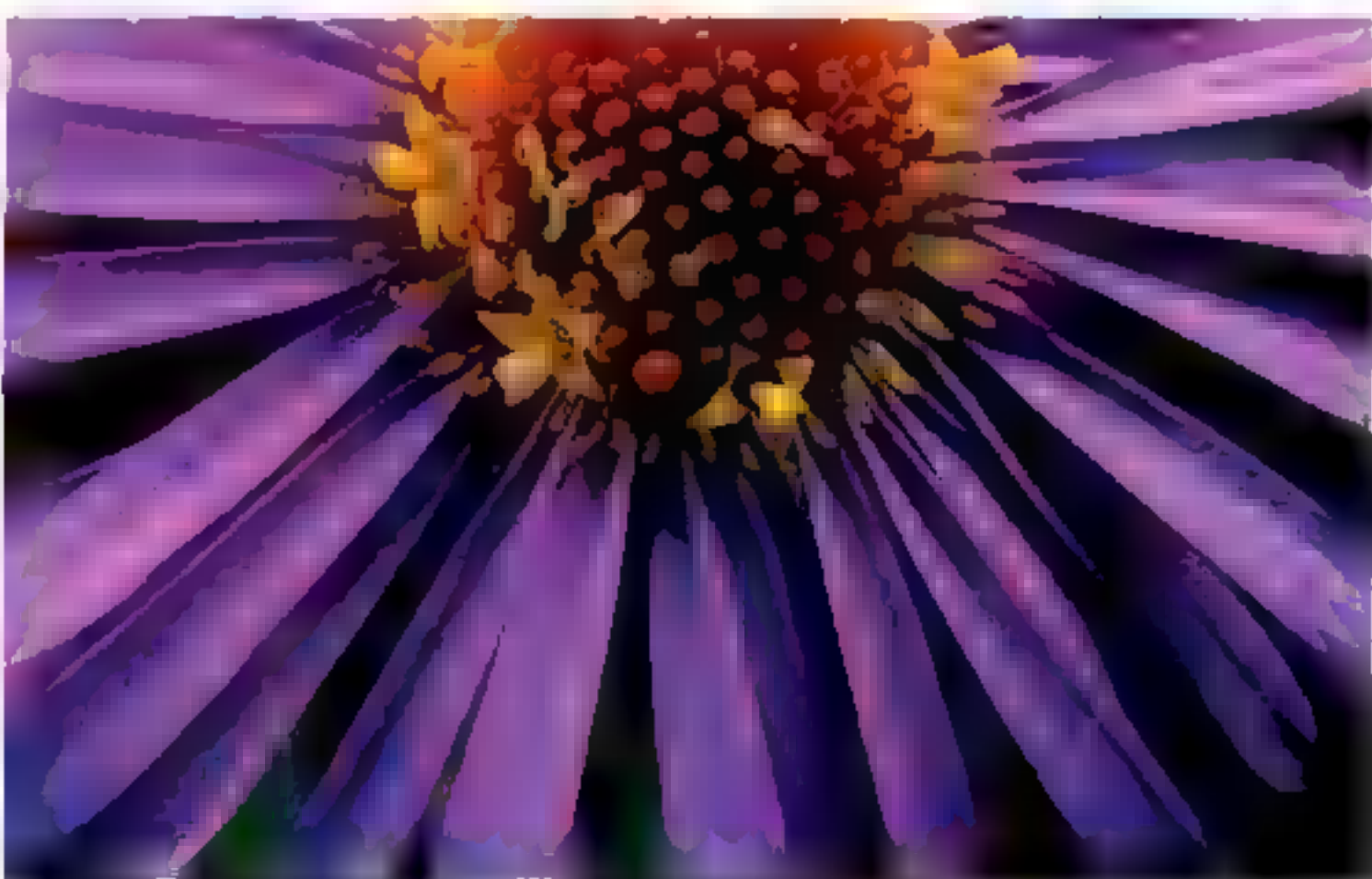
**Floral delights** please the eye and soothe the body. An ornamental, *Berberis* (above) yields a tonic taken to ease intestinal distress. With its galaxy of blossoms *Androsace* (below left) is popular in rock gardens. The odd *Helwingia japonica* (below right) sprouts star-shaped flowers mid-leaf. The aster (bottom left) is widely used as ground cover and in flower arrangements. Chinese botanists cultivate the endangered *Rhododendron orbiculare* (bottom right) to restock the wilderness.



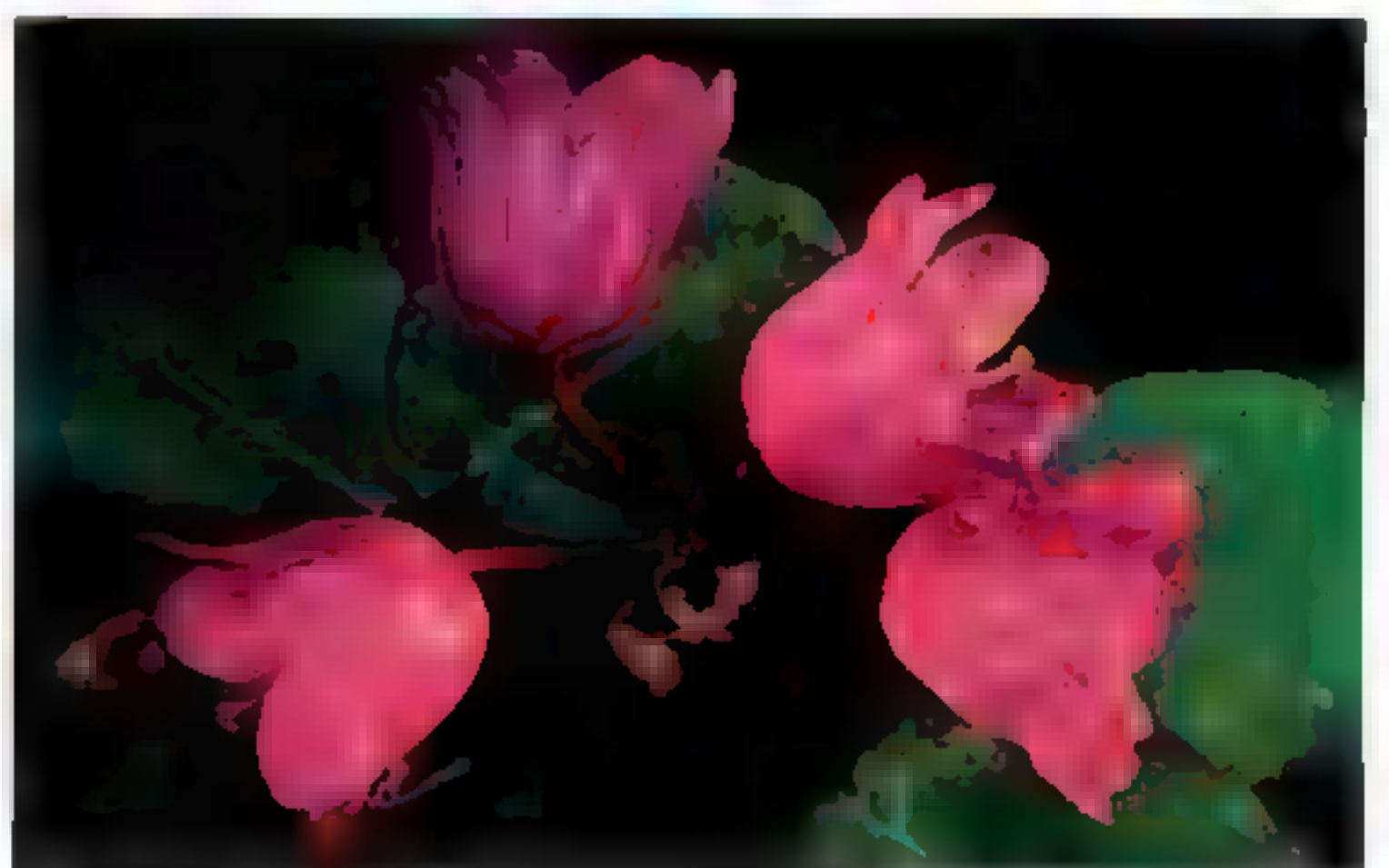
ANDROSACE SP.



HELWINGIA JAPONICA



ASTER TONGOLENSIS



RHODODENDRON ORBICULARE



white-eyes and chestnut thrushes flitted among the bushes, and overhead a large troop of cinnamon-colored, stump-tailed macaques crashed through the trees. "That's a good sign," Yin said, pausing to watch the fleeing monkeys. "A few years ago we seldom saw a macaque—and never a troop this big. I think it shows the hunting ban is working." Then Yin stopped beneath a hoary oak tree and pointed at one strappy-leaved plant growing on a mossy branch. "There it is. That's the 'flying lily,' the rare plant that had helped him preserve this forest. His colleague discovered the plant, Yin laughed, because he happened to glance up during a call of nature. "That lily grows only in a very narrow range between 6,500 and 7,200 feet," he added. "If we hadn't saved this valley, the lily might have been lost forever."

Persuading the government to preserve the valley pushed Yin and other Chinese conservationists to try to protect more of the forest. In 1995 the government agreed to set aside about 1,550 square miles of Mount Gongga's remaining woodlands and meadows. Now, with the bans against hunting and logging in place, the mountain is largely protected.

The transition from a logging to a tourism economy was rough at first, said Yin. But now many of his friends—men of the Yi people who had worked for him as guides and hunted for a living—are rangers in the new park. Others have opened restaurants or work at the hotels. "I told them tourism would give them a better life," Yin said. "No one believed me. They said, 'This is a fairy tale.' Now even those who opposed me are building guesthouses."

At first glance outsiders may also regard the Chinese government's newfound enthusiasm for ecotourism as little more than a fairy tale. But this is a culture where citizens respond to the directives of the central government, which is now encouraging the growing middle class to spend some of its money on travel. "People used to go only to forests where there are temples and Buddhist monasteries," explained our interpreter. "That is our tradition. Now we are going to places like the Hailuogou Glacier just to see the glacier and the forest for their beauty. And that is something new for us."

From the valley of the flying lily we drove higher up Mount Gongga to a parking lot just below Hailuogou Glacier. Although the trail to the glacier was still under construction, visitors

were already setting out on it. All were dressed as if arriving for a social occasion: the men in suits and dress shoes gleaming with polish; the women in slacks, sweater sets, and dainty sandals, their hair perfectly coiffed, their lipstick and nail polish shining. Few actually walked to the glacier; most preferred to be carried in chairs slung on two poles and hefted by two strong men. "We are seeing our country, the beauty of it," one couple told me when I asked what had brought them to Hailuogou. "And we want to walk on the glacier." A few miles up the trail the carriers unloaded their burdens, and the tourists headed tentatively onto the ice in their city shoes, laughing and slipping and then simply stopping to admire the long tongue of the glacier that drifted in and out of view under a low-lying cloud.

At the trailhead local people earned extra money by selling mushrooms, herbs, and medicinal plants they had collected in the forest. In other countries such collecting might be prohibited in a national park, but Yin shook his head at this idea. "These plants are important for people's health," he explained. "There are some that can be cultivated, but others have their power only if they are collected in the forest. It may need some regulation, but not all traditions can be changed overnight."

**T**HE DAY AFTER HIKING to the glacier we drove to a nearby Tibetan village. Twenty-two years ago Yin had explored this area on foot, searching for a conifer that the renowned English botanist Ernest Wilson had collected in 1907. Yin had found Wilson's record of the conifer, a rare spruce, in the papers at the Chengdu Institute of Biology. None of Yin's colleagues, however, could remember seeing the tree in the wild.

On his 1980 expedition Yin was accompanied by a young director of land use for the county, Chen Maolin. "We walked all these hills and valleys," Yin recalled. At that time there was still some forest on the ridges above the valley, but the trees were cut sometime later, and today only shrubs and spindly young evergreens dot the hillsides. The valley itself is green with cabbages and broccoli growing in neat rows. Nevertheless, here in Lao Yu Lin village, Yin and Chen had found Wilson's tree—or what might be the sole survivor. They had taken a picture of it, with Chen facing the camera and beaming





**The call of the wild** draws throngs to the slopes of Yunnan (left). Ecotourism will require a fine balance: collecting revenue from visitors without spoiling the ecosystem through overcrowding. Blessings lured a pilgrim (right) who walked part-way around a sacred mountain, then passed three times under a waterfall, a ritual in which the faithful are literally immersed in nature.

as he pointed at the spruce's tall, stately spire.

"It brought tears to my eyes to see the tree," Yin said as we drove into the same village. "I had searched many years and finally found it in this valley." He hoped to show me the same tree and had brought along Chen, who was now deputy governor of the county, to help re-create the scene of their discovery. But the two men were worried. They'd heard rumors that their tree had been cut down. And in the short one-mile stretch of village, certainly no towering conifers were to be seen.

Yin's driver parked the car, and the two men, looking glum, walked up a narrow path to investigate. A few minutes later Yin appeared again, waving and calling to me. "Yes, yes, the tree is gone," he said. "I'll show you where it was." We walked through some fenced yards, and he pointed to a low wall. "See, its trunk is still there; it's part of the wall now." Yin took a deep breath and patted his heart. "I feel very sad to see this." He stopped for a moment, then continued. The owner of the land, it seemed, had cut down the tree to make coffins for herself and her husband. He had died a few years ago, and she herself was 89, a bent branch of a woman, and terrified that Yin, Chen (the deputy governor, no less), and a foreigner had come to see her tree. She'd run away from us, locked herself in her house, and wasn't opening the door for anyone.

Yin shook his head. "Now, look here," he said, smiling once again and pointing to several

young conifers that had sprouted a short distance from where the precious tree had stood. "I can't be absolutely sure yet—because I have to wait until one produces a cone—but I'm fairly certain these are the babies of that tree." There were 12 of the young conifers, all about two feet tall, growing in a neighbor's yard. The neighbor's son had stepped out to see what all the commotion was about, and he stood now among the prized trees. Yin grasped him by the hand. "The trees are young like you," he said. "And you must care for them, protect them."

"And if you don't, if you hurt any of these little trees," added Chen, wagging a finger at the young man, "I'll find you, and I'll. . . ." He didn't finish his threat, and everyone laughed.

On a concrete wall outside the village someone had painted an environmental slogan in large, red Chinese characters: "Benefit your children. Save the trees." In the 1960s, when Yin began his collecting campaign, other slogans had been painted on the walls that encouraged villagers to cut down trees and use the wood to make steel and develop China. That was why this valley's hillsides were bare. But the young people of today, like the boy Yin had just charged with protecting the spruce seedlings, were reading different slogans and learning a new ethic. Yin said it gave him reason for hope. □


**MORE** ENVIRONMENTAL

Many plants in your garden may have come from China. Find out more at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204). AOL Keyword: NatGeoMag







A large number of Mexican free-tailed bats are shown in flight against a dark blue night sky. The bats are silhouetted against the sky, with their wings spread, creating a dense pattern of white and light blue shapes. The background is a deep, dark blue, suggesting a clear night. The overall scene is a dramatic and powerful display of nature's nocturnal activity.

Winged eating machines, Mexican free-tailed bats emerge from Bracken Cave, near San Antonio, Texas, for their nightly flight. Their search for insect prey will take them to great heights—10,000 feet.

# Bat Patrol

Scientific American





What might flying mammals are bad news for birds.



By Gary F. McCracken and  
John K. Westbrook

Photographs by Jay Dickman

**E**ach summer evening in south-central Texas one of nature's great spectacles unfolds. From the long, narrow mouth of Bracken Cave, near San Antonio, a stream of Mexican free-tailed bats begins to emerge a few hours before sundown. For more than two hours they leave the cave and spiral higher and higher, an immense cloud of 20 million bats, the world's largest known colony. Finally the columns disappear beyond the view of our binoculars.

For many years the two of us have watched free-tailed bats emerge from Bracken and other caves nearby. We wondered: Where are these bats going? How high do they fly? Are they feeding up there, and if so, on which insects and how many?

We suspected that they might be headed to dinner above the Winter Garden agricultural region, several hundred thousand acres of corn, cotton, and vegetables southwest of San Antonio. Those fields are infested with billions of insects, many of which cause immense

### Hunting at Altitude

Just before dawn over south-central Texas, researchers Gary McCracken, center, and John Westbrook, right, ride a hot-air balloon to 5,000 feet in search of bats. Doppler radar had shown the scientists that bats fly at twice that altitude.









# Radar Tracks Attack



Range of Mexican free-tailed bat (*Frederia brasiliensis mexicana*)

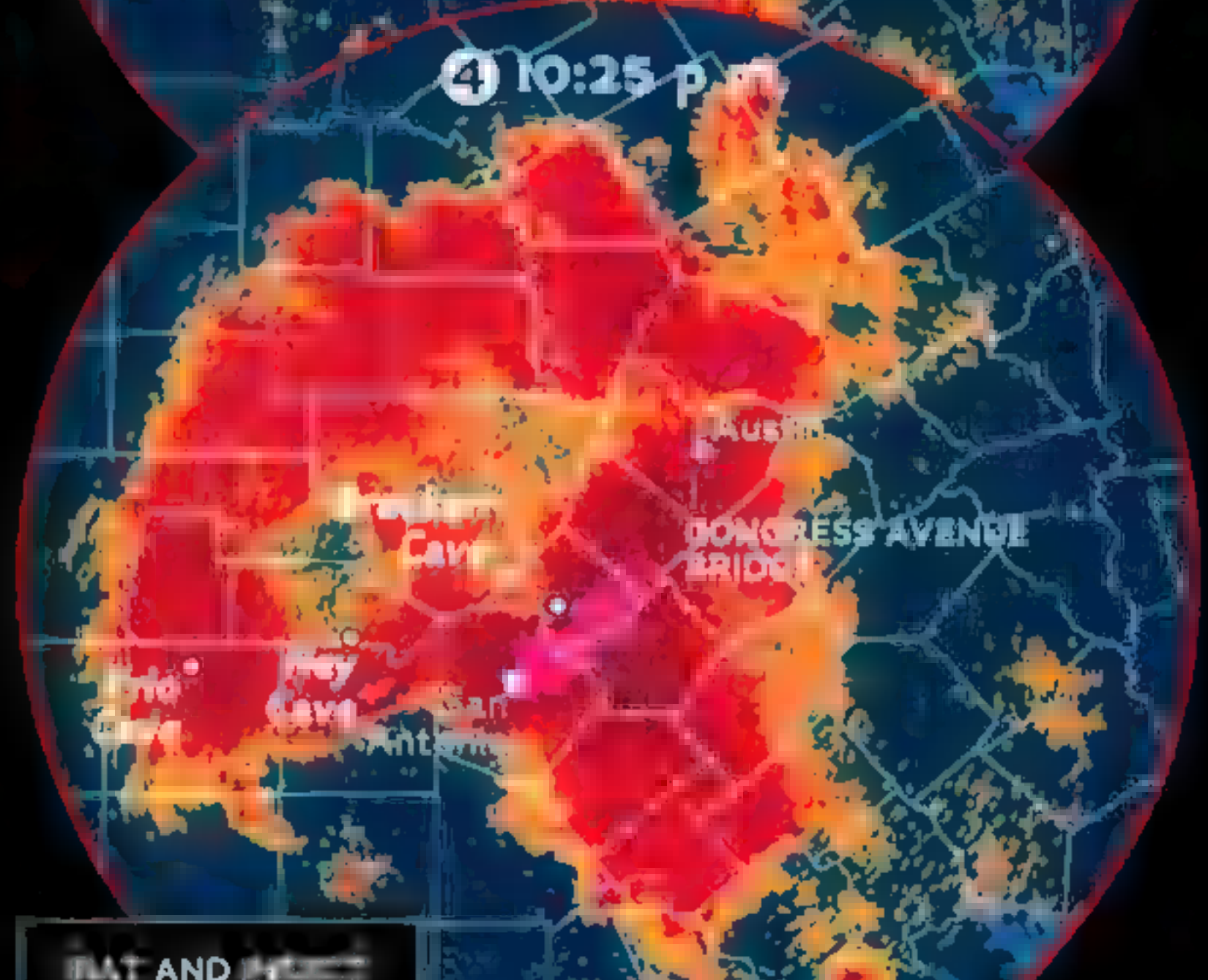
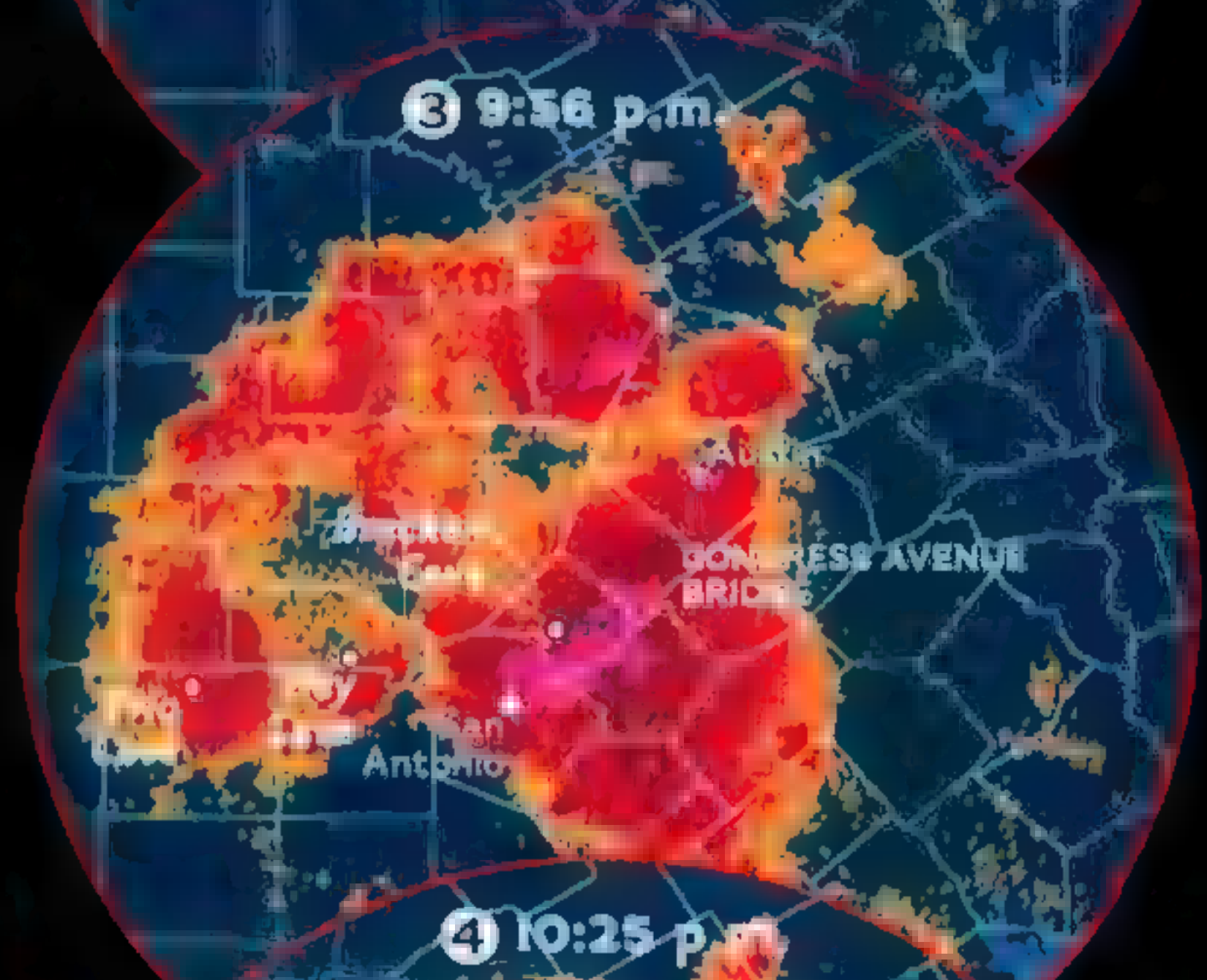


Doppler weather radar installed near San Antonio was designed to track storms, but it also picks up night-flying bats.

The bats winter in Mexico and migrate to Texas in spring. Billions of insects begin arriving in early June to lay their eggs in and around the Winter Garden region. By late in the month, the next generation has begun to leave the fields and fly over Bracken Cave, home to 20 million bats, and Ney and Frio Caves, each with 10 million.

Radar images (right) show what happens on a typical summer night. At dusk, top, bats can be seen emerging from caves. They mix with insects as they swarm to feed, mostly between 600 and 3,200 feet, some rising as high as 10,000 feet. By

10:25 roughly a million bats from under Congress Avenue Bridge have joined in the hunt. Elapsed time: less than an hour and a half.



See an animation of bat radar tracking bats at <http://www.nationalgeographic.com/ngm/0204>.





PHOTO: MERLIN TUTTLE, BAT CONSERVATION INTERNATIONAL

damage to the crops. Eventually we decided to see for ourselves—by flying with the bats.

Back in the spring of 1995 we had learned of another party privy to the bats' nocturnal flights, a sort of visual eavesdropper only 19 miles from Bracken Cave. There, in the community of New Braunfels, the National Weather Service had built a Doppler radar facility.

Doppler radar tracks moving objects such as raindrops through the atmosphere by bouncing electromagnetic energy off them and measuring the amplitude as well as the change in frequency. But the radar doesn't distinguish between bats and hailstones. To the radar the millions of bats emerging from their caves look like a huge storm that starts at a point on the ground—a cave—and spreads rapidly up and over the landscape.

"It didn't take long for word to get around among bat researchers that we could view bat colonies on the new radar," recalls Jim Ward, science and operations officer at New Braunfels. "We saw bats flying as high as 10,000 feet."

Ward alerted Merlin Tuttle, director of Bat Conservation International in Austin, about the radar's bat-tracking ability. Merlin contacted us, and a project was born: We realized that Doppler radar could help us determine how the airborne bats interacted with insects.

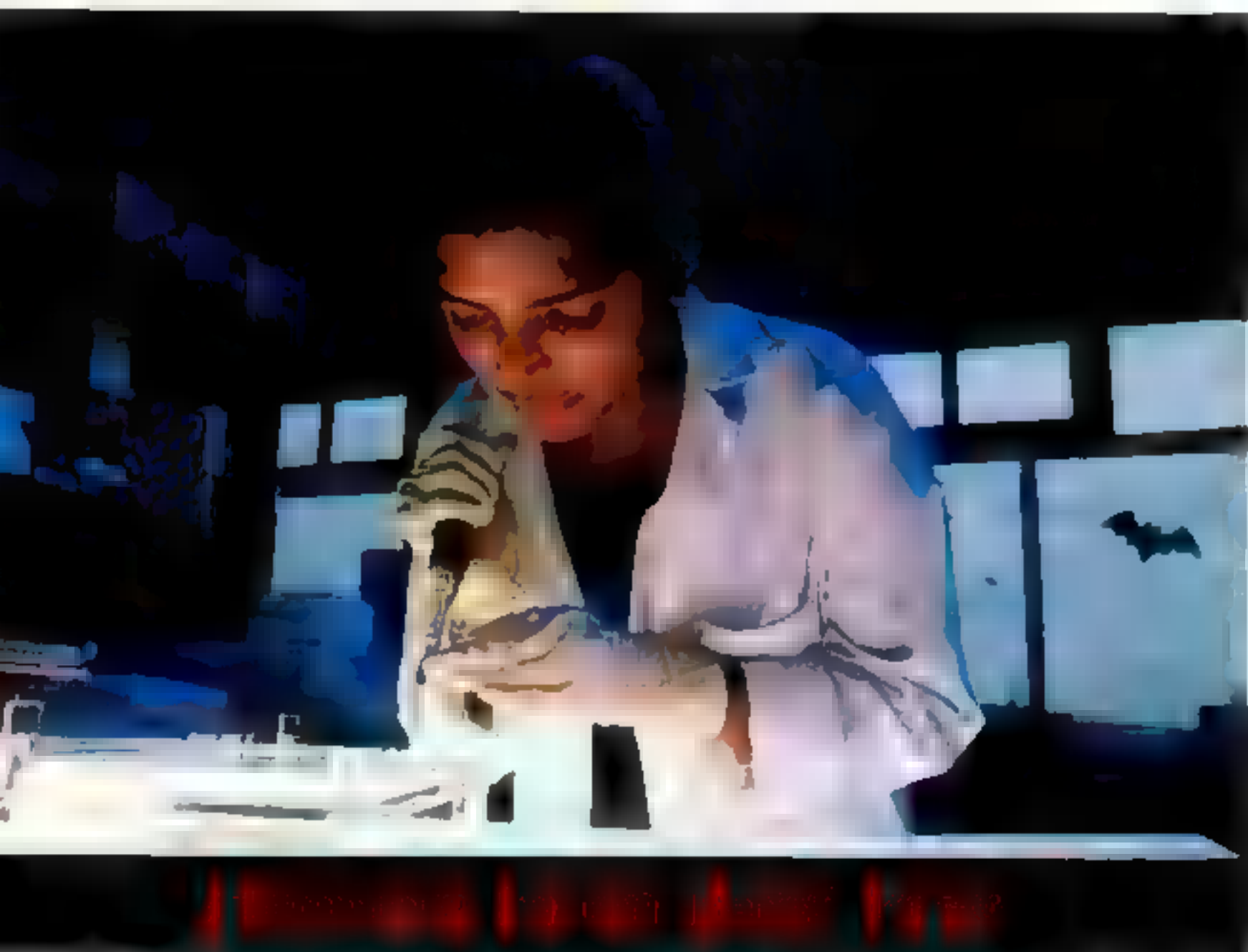
### Natural Pest Killers

**Public Enemy Number One for many farmers, a corn earworm moth will soon be bat supper. Each summer in south-central Texas legions of insects attack corn, cotton, and other crops before heading north. Bats eat as much as two million pounds of bugs in a night.**

**T**HE NIGHTLY FLIGHTS in spring and early summer involve an estimated 100 million Mexican free-tailed bats emerging from a dozen major caves in south-central Texas. Perhaps another 50 million live in caves in Oklahoma, New Mexico, and Arizona. These bat populations are maternity colonies, huge congregations of females that migrate into the southwestern United States each spring from wintering grounds in Mexico. In June each female gives birth to a single pup. She leaves the cave twice each night to feed, returning to nurse the pup. By late July the young bats have grown enough to hunt with their mothers, doubling the number of bats flying from the caves.

To feed herself and her growing pup, a female bat must eat the equivalent of up to 70 percent of her body weight each night. Although each bat weighs only half an ounce





**DNA tests by University of Tennessee researcher Sunitha Vege pinpointed corn earworm and tobacco budworm moths in bats' feces. While nursing hungry pups (right), female freetail bats need to eat up to 70 percent of their weight in insects nightly.**

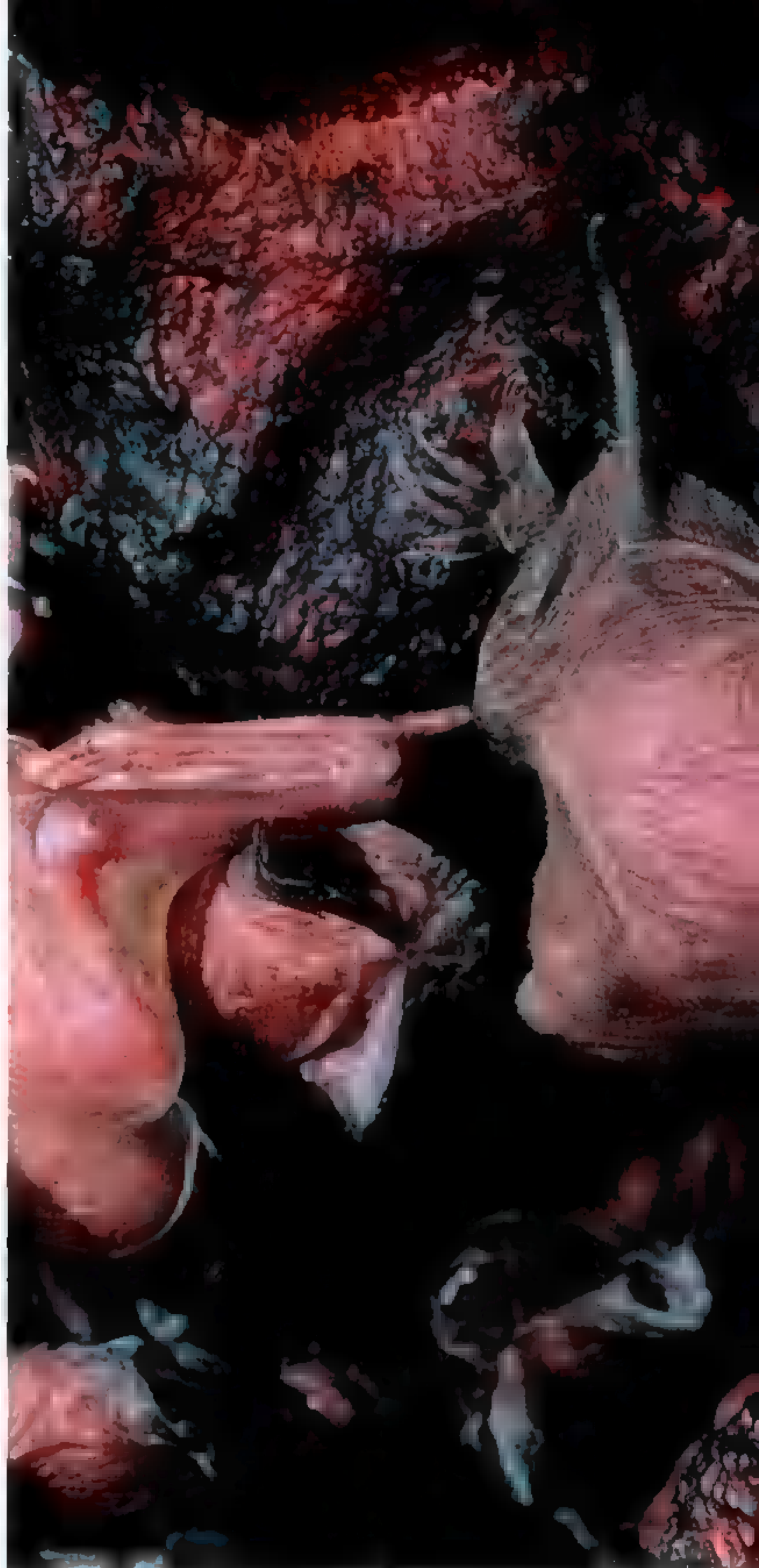
or so, calculations show that a million bats can devour about ten tons of insects nightly. That means the 100 million free-tailed bats in south-central Texas must eat an incredible 1,000 tons—two million pounds—of insects in a single night.

Since bats in other locales pursue insects close to the ground, we wondered why the free-tails were flying as high as 10,000 feet. Is this where they find the billions of insects needed to sustain their huge populations?

Again, Doppler radar offered clues by detecting the billions of insects that swarm high above Texas. Since the 1980s researchers from the United States Department of Agriculture have used radar to map the flight patterns of some of North America's most destructive agricultural pests—fall armyworms, beet armyworms, tobacco budworms, and, the worst of all, corn earworms.

Corn earworms and tobacco budworms alone cost U.S. farmers over a billion dollars annually. To control them, Texas cotton growers spread nearly 30 million dollars' worth of insecticides between 1995 and 1997 but still lost an annual average of 148,000 bales of cotton (each worth \$350).

"Some years we've had to spray three to five times at a cost of \$30 to \$50 an acre," says Ray King, a farmer in the Winter Garden. "I'll never forget June of 1995 when the beet



armyworms ate our lunch. We'd have been better off if we'd just let them have the crop."

During the first weeks of June each year—about the time the bats give birth—up to seven billion corn earworm moths, plus a similar number of fall armyworm moths and other pests, emerge from the cornfields of the lower Rio Grande Valley. After dusk they ascend anywhere from hundreds to thousands of feet and ride the prevailing winds north to the Winter Garden. They can make the 250-mile flight in one night. Each female then lays as many as a thousand eggs in corn, cotton, and other crops, where the larvae grow fat as they mature.

Texas farmers are only the first in the United





MERLIN D. TUTTLE

States to suffer. In late June and early July the next generation of moths hatches and flies north, eventually invading crops across the central United States and into Canada. If we could prove that bats were eating corn earworms in Texas, we could show that they're an unrecognized first line of defense against invading insect hordes and that without the bats the damage to farmers in Texas and farther north could be even worse.

Conventional analysis of the bats' digestive remains told us that they ate moths—but not what kind. During much of the summer moths make up 30 to 40 percent of the bats' diet. That figure rises to an astounding

90 percent during the peak of moth migration from Mexico into Texas. Ya-Fu Lee, a researcher at the University of Tennessee, had examined bat feces from several colonies and discovered a striking relationship between the moths' arrival and their proportion in the bat droppings.

**B**UT WE STILL DIDN'T KNOW exactly what the bats were doing high above those Texas fields. What we did know is that a cruising bat emits a search call as it looks for food. When it attacks, its call changes to a rapid repetition known as a feeding buzz. We can identify different bat species





## Bug Bats Are Heroes

**In 1997 Texas farmers spent 345 million dollars on pesticides, yet corn earworms and tobacco budworms alone still destroyed tens of millions of dollars' worth of crops. Without bats, and efforts to conserve them, the damage could be far greater.**

by their distinctive calls. Though these calls are above the limits of human hearing, electronic bat detectors make them audible to us. The detectors' range is limited, so the trick is to get them airborne, near the bats.

We had first tried in 1996 by attaching

bat detectors and radio transmitters to helium balloons. As they rose, we chased them across Texas in a van, tracking the signals with a radio receiver. It was primitive, but it worked: We picked up transmissions of freetail search calls at 3,900 feet and feeding sounds at 2,400 feet.

The next year we attached radio microphones to kites used to monitor atmospheric pollutants. We heard the bats feeding as high as we could raise the kites—4,000 feet. And we heard them in great numbers. Clearly, at times there's a feeding frenzy up there.

Based on that experience, we decided we needed to witness their aerial feeding. There was only one way to do that.





“Hot-air balloons are the safest mode of aviation,” our pilot assured us as we prepared to ascend in the predawn August darkness near Uvalde. Launching and flying at night isn’t a problem—but landing can be. In the dark, power lines and barbed wire fences create invisible hazards during descent.

So it would be a quick two-to-three-hour flight, then hopefully a safe landing soon after dawn. It was still pitch-black when we rose from Ray King’s farm near Frio Cave. We drifted silently, save for occasional blasts from the propane burners, which kept us aloft. To the bats we must have looked like a giant lightbulb. As the sun began to rise, we could see

deer scattering below us in the dim light and the faint outline of a hawk in a tree.

When we rose to several thousand feet, we began to hear bats. Our pilot pointed to a group close to the balloon, apparently investigating the large object that had invaded their airspace. They were Mexican freetail. As we approached 5,000 feet—the limit of our flight plan—we saw and heard more freetails and recorded their feeding buzzes with bat detectors. But we saw only a few moths, mostly in the distance.

Already it was daylight. Shortly after dawn we bumped down, exhilarated but a bit disappointed. Where was the feeding frenzy? We had flown in August, well after the June moth migrations from Mexico, so a subsequent generation of moths was already leaving en masse from the patchwork of crops far below us. Billions of these insects should have been flying at our altitude. Why had we seen so few?

Simple math eased our disappointment. Although Doppler radar shows billions of moths as a huge cloud, we later calculated that the density—from our vantage point in the balloon—translated to perhaps one moth per 30,000 cubic feet of airspace. With 20/20 hindsight we realized that we shouldn’t have expected to see swarms of moths.

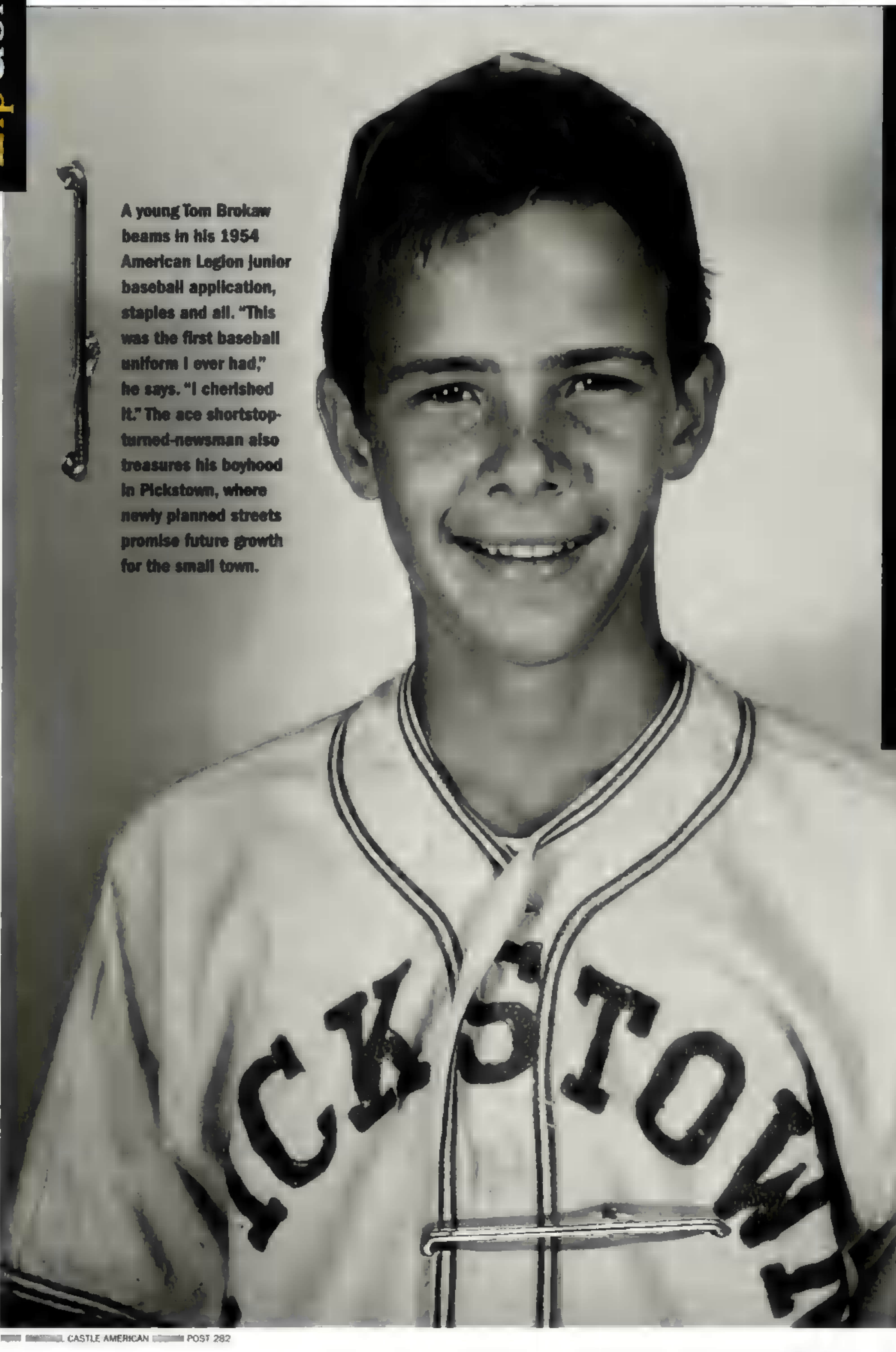
Later DNA analysis of the insect remains in bat feces by Sunitha Vege, a graduate student at the University of Tennessee, finally confirmed our suspicion: The insects in the free-tails’ droppings are in fact corn earworms and tobacco budworms.

Our project now involves more than a dozen scientists in the U.S. and Mexico. Together we are trying to determine the dollar value of the bats. How much crop damage would there be without the freetails? How many more tons of insecticides would farmers need to spray if it weren’t for the bats? Even before these questions are answered, however, it’s clear that we need to safeguard our free-tailed bats, which cost us little to protect but could cost us a great deal if we lose them. □

#### MORE INFORMATION

**ON OUR WEBSITE** Watch video footage of more than a million bats flooding the skies over Austin, and get tips from Bat Conservation International on how to help save bats worldwide at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204). AOL Keyword: NatGeoMag



A black and white photograph of a young Tom Brokaw, smiling and wearing a baseball uniform. The uniform has "PICKSTOWN" written across the chest in large, bold letters. He is wearing a dark baseball cap. The background is a plain, light-colored wall.

A young Tom Brokaw beams in his 1954 American Legion junior baseball application, staples and all. "This was the first baseball uniform I ever had," he says. "I cherished it." The ace shortstop-turned-newsman also treasures his boyhood in Pickstown, where newly planned streets promise future growth for the small town.





# 57367

## Tom Brokaw Steals Home

On a high bluff overlooking the Missouri River in south-central South Dakota stands a kind of monument to the can-do spirit, and the hubris, of the U.S. Army Corps of Engineers in the years immediately following World War II. It is what's left of Pickstown, a once vibrant community of workers who came here to build the first of five large dams constructed across the Missouri in the 1940s and '50s. That dam was called Fort Randall after an old cavalry fort nearby, where Sitting Bull was once a prisoner. It was in such a remote area the Corps had to build Pickstown from scratch

BY TOM BROKAW

PHOTOGRAPHS BY VINCENT J. MUSI







U.S. ARMY CORPS OF ENGINEERS

to handle the sudden migration of workers required for the project. My family moved there from an Army base in western South Dakota in 1948.

We moved into a three-bedroom duplex while construction on the town went on around us. Soon we had paved streets, a large movie theater, hospital, church, police and fire station, and shopping center complete with a bak-

ery, department store, and soda fountain. I started the third grade in a two-story school with state-of-the-art classrooms and athletic facilities.

My father was a heavy equipment operator on the town maintenance crew, and my mother worked as a clerk in the post office, where I always studied the FBI's Most Wanted posters carefully, thinking the suspects might show up in Pickstown. They never did.

But for a time it seemed everyone else did, as the population quickly grew to 3,500: Caterpillar operators from Mississippi, welders from Montana, truck drivers from Minnesota, mechanics from Oklahoma. The town dentist came from Indiana. One nurse was an Irish war bride.

The other half of our duplex was home to a family of amateur country-and-western musicians from southern Illinois. Their record player could be heard through our common wall, and to this day I still remember most of the lyrics to "Cattle Call" by Eddie Arnold.

Along the river and in the surrounding hills I had a Tom Sawyer boyhood, swimming in the Missouri, collecting fossils and Indian artifacts, hunting small game with my friends, including Sylvan Highrock, a Sioux who lived with his large family in a cabin a few miles from town.

I was only vaguely aware that this was Indian territory and that Pickstown was surrounded by the Yankton Sioux Reservation. No one said

57367

**FULL-TIME POPULATION:**

168

**PEAK (IN THE 1950s):**

3,500

**LOW (IN 1990):** 94

**NUMBER OF STOPLIGHTS, ELEVATORS, LIBRARY**

**STORES, SCHOOLS:** None

**LARGEST EMPLOYER:**

Fort Randall Bait & Tackle, with about 20 people in the summer

**NOTABLE RECORD:**

The 1986 world-record flathead catfish, 54 pounds, caught by Marlin Horsley

**BIG CHALLENGE:** Third fastest growing town in South Dakota

As federal workers (top) poured in to build the Fort Randall Dam and power plant, Pickstown and its main attraction—Lake Francis Case—were born.







much when the Yankton Sioux families of my friends Peter Archambeau and Armand Hopkins were forced to give up their homes to make room for the lake that backed up behind the slowly emerging dam.

Seven days a week, 24 hours a day, for seven years the work went on, creating a long, earth-rolled berm that closed off the river's natural channel and redirected the power of the Missouri through eight huge turbines to generate electricity for South and North Dakota, Iowa, Minnesota, Nebraska, Colorado, and Montana. Then in 1956 work on the dam was completed, and families packed up and left town. We moved downstream to another dam, where my father had been transferred by the Corps.

When I returned a few years ago for a reunion of the original population, Pickstown was in a modest renewal as a retirement, hunting and fishing community. The federal government had turned the town over to residents, who incorporated as the state's newest municipality in 1986 and began selling lots to finance the community's minimal services.

For two of the residents the circle is complete. When I was a boy, Roland Hatwan and Darlene Salisbury were one of the town's dashing couples. He was a ranch kid who went to work on the dam at 18. He's now 72, retired, and newly remarried—to Darlene. They rediscovered each other at the reunion, and she moved back to Pickstown from California to share his leisurely life, which he describes as "going to coffee, driving around, and waiting for hunting season to start."

Roland and his buddies gather for coffee almost every morning at a local café and bait shop owned by Cindy and Bryce Broyhill, émigrés from Nebraska. Cindy figures about two-thirds of the business is related to fishing for walleye, smallmouth bass, and catfish during the summer and hunting for deer, pheasant, and waterfowl in the fall.



**Going nowhere fast with a flooded engine, the Vander family years hit the lake. "Everybody here has a boat," says Fred Kocer (top), who displays love of fishing and hunting—and of his wife, Alice—at their home. "This is paradise," he says.**





Cindy and Bryce like the quiet pace of Pickstown, but they worry that if it fails to attract some younger families, the town will fade again. They drive their children 14 miles to Wagner for school, and specialty medical attention means a four-hour drive to Omaha.

I found my schoolboy friend Armand Hopkins at the Yankton Sioux casino and restaurant on the reservation. We laughed about the time we skipped school to go fishing in the river before his father's farm was submerged by the lake. Now Armand and some other Sioux are petitioning the federal government to get additional compensation for their lands that were condemned. They say they had been paid only \$33 an acre at the time, and they figure it's worth at least twice as much.

Armand knew that 25 years ago I had bought a headstone to mark the grave of my friend Sylvan Highrock, who had died from too much drinking. When I asked about other Indian friends, the answer was a depressing litany. "Elmer Ashes?" "Dead," he said. "Peter Archambeau?" "Dead," Armand said. "They're all dead."

Survival is a point of pride for Armand and a subject that weighs on Sonny Soulek, a regular at the bait shop coffee klatch. Sonny returned from a hellish time in Vietnam with what he calls survivor's guilt. He's undergone therapy and returned to the family farm not far from Pickstown, hunting and fishing and reflecting on what it's been like to grow up in this corner of South Dakota. "There were two kinds of people," he says, "the tough and the dead."

Even during the boom times when I was living there, it was a place for the tough. The winters are long and usually harsh. And there haven't been many good jobs since the dam was finished in 1956. But while Pickstown may not be what it once was, it still is framed by the natural beauty of the ancient river, the sweep of the Great Plains, and the long, unbroken shoreline of the lake behind the dam. It gave me a 19th-century childhood in a modern mid-20th-century town, and for that I will always be grateful. □

**Sweaty from a game of sandlot ball, best friends Cody Snyder and Ryan Cooney holst a trophy. "It was just for doing good baseball," says Ryan, at right. With barely enough kids to field a team, spirit counts more than the score in Pickstown.**

**ON OUR WEBSITE** There's more on 57367 at [nationalgeographic.com/ngm/0204](http://nationalgeographic.com/ngm/0204). Tell us why we should cover **YOUR FAVORITE ZIP CODE** at [nationalgeographic.com/ngm/zipcode/0204](http://nationalgeographic.com/ngm/zipcode/0204) or mail your suggestion to PO Box 96095, Washington, DC 20090-6095. E-mail: [zip@nationalgeographic.com](mailto:zip@nationalgeographic.com)



For people with type 2 diabetes

**"By taking care  
of my diabetes,  
I take care of my family."**

**Avandia**<sup>®</sup>  
rosiglitazone maleate



"I've made the commitment for myself, but it's also for my family. For my wife and my two beautiful daughters – they're everything to me. All I have to do is look at them, any one of them, and I find the strength, all the reason, all the determination I need to take better care of myself.

"I was eating better, exercising more. But that still wasn't enough. So my doctor added *Avandia*. It makes my body more responsive to its own natural insulin, so I can control my blood sugar more effectively.

"So finally, with the help of *Avandia*, I'm controlling my type 2 diabetes, instead of the other way around. And while not everybody gets the same results, I've been able to keep my blood sugar down for just about a year now. That's the strength of doing things right."

*Avandia*, along with diet and exercise, helps improve blood sugar control. It may be prescribed alone, with Glucophage<sup>®</sup> (metformin HCl tablets) or with sulfonylureas. When taking *Avandia* with a sulfonylurea, you may be at risk for low blood sugar. Ask


your doctor whether you need to lower your sulfonylurea dosage. Some people may experience tiredness, weight gain or swelling with *Avandia*.


*Avandia* in combination with insulin may increase the risk of serious heart problems. Because of this, talk to your doctor before using *Avandia* and insulin together. *Avandia* may cause fluid retention, or swelling, which could lead to or worsen heart failure, so tell your doctor if you have a history of these conditions. If you experience an unusually rapid increase in weight, swelling or shortness of breath while taking *Avandia*, talk to your doctor immediately. *Avandia* is not for everyone. If you have severe heart failure or active liver disease, *Avandia* is not recommended.

Also, blood tests to check for serious liver problems should be conducted before and during *Avandia* therapy. Tell your doctor if you have liver disease, or if you experience unexplained tiredness, stomach problems, dark urine or yellowing of the skin while taking *Avandia*. See important patient information on the following page.



**AVANDIA<sup>®</sup>. Help use the natural insulin in you.<sup>™</sup>**

**I am stronger than diabetes.<sup>®</sup>**

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Talk to your doctor, or for more information

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or visit [www.avandia.com](http://www.avandia.com)



## Patient Information about AVANDIA® (rosiglitazone maleate) 2 mg, 4 mg, and 8 mg Tablets

### What is *Avandia*?

*Avandia* is one product in a class of prescription drugs called thiazolidinediones (thigh-a-zol-a-deen-die-owns) or TZDs. It is used to treat type 2 diabetes by helping the body use the insulin that it is already making. *Avandia* comes as pills that can be taken either once a day or twice a day to help improve blood sugar levels.

### How does *Avandia* treat type 2 diabetes?

If you have type 2 diabetes, your body probably still produces insulin but it is not able to use the insulin efficiently. Insulin is needed to allow sugar to be carried from the bloodstream into many cells of the body for energy. If insulin is not being used correctly, sugar does not enter the cells very well and builds up in the blood. If not controlled, the high blood sugar level can lead to serious medical problems, including kidney damage, blindness and amputation.

*Avandia* helps your body use insulin by making the cells more sensitive to insulin so that the sugar can enter the cell.

### How quickly will *Avandia* begin to work?

*Avandia* begins to reduce blood sugar levels within 2 weeks. However, since *Avandia* works to address an important underlying cause of type 2 diabetes, insulin resistance, it may take 8 to 12 weeks to reach the full effect. If you do not respond adequately to your starting dose of *Avandia*, your physician may increase your daily dose to improve your blood sugar control.

### How should I take *Avandia*?

Your doctor may tell you to take *Avandia* once a day or twice a day (in the morning and evening). It can be taken with or without meals. Food does not affect how *Avandia* works. To help you remember to take *Avandia*, you may want to take it at the same time every day.

### What if I miss a dose?

If your doctor has prescribed *Avandia* for use once a day:

- As soon as you remember your missed dose, take one tablet anytime during the day.
- If you forget and go a whole day without taking a dose, don't try to make it up by adding another dose on the following day. Forget about the missed dose and simply follow your normal schedule.

If your doctor has prescribed *Avandia* for use twice a day:

- As soon as you remember the missed dose, take one tablet.
- Take the next dose at the normal time on the same day.
- Don't try to make up a missed dose from the day before.
- You should never take three doses on any single day in order to make up for a missed dose the day before.

### Do I need to test my blood for sugar while using *Avandia*?

Yes, you should follow your doctor's instructions about your at-home testing schedule.

### Does *Avandia* cure type 2 diabetes?

Currently there is no cure for diabetes. The only way to avoid the effects of the disease is to maintain good blood sugar control by following your doctor's advice for diet, exercise, weight control, and medication. *Avandia*, alone or in combination with other antidiabetic drugs (i.e., sulfonylureas or metformin), may improve these other efforts by helping your body make better use of the insulin it already produces.

### Can I take *Avandia* with other medications?

*Avandia* has been taken safely by people using other medications, including other antidiabetic medications, birth control pills, warfarin (a blood thinner), Zantac® (ranitidine, an antiulcer product from GlaxoSmithKline), certain heart medications, and some cholesterol-lowering products. You should discuss with your doctor the most appropriate plan for you. If you are taking prescription or over-the-counter products for your diabetes or for conditions other than diabetes, be sure to tell your doctor. Sometimes a patient who is taking two antidiabetic medications each day can become irritable, lightheaded or excessively tired. Tell your doctor if this occurs; your blood sugar levels may be dropping too low, and the dose of your medication may need to be reduced.

### What should I discuss with my doctor before taking *Avandia*?

*Avandia* in combination with insulin may increase the risk of serious heart problems. Because of this, talk to your doctor before using *Avandia* and insulin together. *Avandia* may cause fluid retention or swelling which could lead to or worsen heart failure, so tell your doctor if you have a history of these conditions. You should also talk to your doctor if you have liver problems, or if you are nursing, pregnant or thinking of becoming pregnant. If you are a premenopausal woman who is not ovulating, you should know that *Avandia* therapy may result in the resumption of ovulation, which may increase your chances of becoming pregnant. Therefore, you may need to consider birth control options.

### What are the possible side effects of *Avandia*?

*Avandia* was generally well tolerated in clinical trials. The most common side effects reported by people taking *Avandia* were upper respiratory infection (cold-like symptoms) and headache. As with most other diabetes medications, you may experience an increase in weight. You may also experience edema (swelling) and/or anemia (tiredness). If you experience any swelling of your extremities (e.g., legs, ankles) or tiredness, notify your doctor. Talk to your doctor immediately if you experience edema, shortness of breath, an unusually rapid increase in weight, or other symptoms of heart failure.

### Who should not use *Avandia*?

You should not take *Avandia* if you are in the later stages of heart failure or if you have active liver disease. The following people should also not take *Avandia*: People with type 1 diabetes, people who experienced yellowing of the skin with Rezulin® (troglitazone, Parke-Davis), people who are allergic to *Avandia* or any of its components and people with diabetic ketoacidosis.

### Why are laboratory tests recommended?

Your doctor may conduct blood tests to measure your blood sugar control. Blood tests to check for serious liver problems should be conducted before starting *Avandia*, every 2 months during the first year, and periodically thereafter.

It is important that you call your doctor immediately if you experience unexplained symptoms of nausea, vomiting, stomach pain, tiredness, anorexia, dark urine, or yellowing of the skin.

### How should I store *Avandia*?

*Avandia* should be stored at room temperature in a child-proof container out of the reach of children. Store *Avandia* in its original container.



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# Final Edit


STYLING: MCCURRY

## TIBETANS

### A Wing and a Prayer

In the shadow of Lhasa's Potala Palace—once seat of Tibetan government and winter home of the Dalai Lama—China's recent past mingles with Tibet's ancient one. The juxtaposition, says illustrations editor Elizabeth Krist, gives this photograph a haunting poignancy. "We needed to get the Potala into the layout early to establish location, because the palace is the most recognizable place in all of Tibet. But this image had too much of a feeling of closure to work early in the layout."

No longer in fighting form, the 1950s-era MiG-15 now attracts tourists at an amusement park, part of a sprawling plaza built in 1995 to commemorate the 30th anniversary of China's creation of the Tibetan Autonomous Region. Visitors can climb into the cockpit of the permanently grounded jet and dream of flight.

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# ON ASSI

ON T ROAD, IN THE FIELD,



**KENYA**

## The Mane Question

*Decoys offer insight into behavior of maneless lions*

**T**hese two lion dummies (above) may not look terribly threatening to us, but they're enough to attract the attention of genuine maneless lions in Kenya's Tsavo East

National Park. "An invasion by a strange lion is the greatest threat a male will ever confront, aside from an armed human being," says author **Philip Caputo** (second from left).

"So the lion must be extremely cautious." The lions' reactions to the decoys, fitted with wigs by researchers Craig Packer (far left) and Peyton West (second from right), reveal much about the role of manes.

Phil—a novelist, former marine, and Pulitzer Prize-winning reporter—first encountered Tsavo's maneless lions as a boy in Chicago, when he saw two specimens in the Field Museum.



# GOVERNMENT

C O V E R I N G T H E W O R L D



“Hardly anyone has subjected them to a really thorough study, although a research team from the museum is working on one,” says Phil, who is currently writing a book on the maneless lions of Africa. He was joined in Tsavo by veteran Africa photographer **Robert Caputo** (no relation). The four also star in an infrared photograph (right); the researchers use such images to measure heat stress on a lion’s body.



ROBERT CAPUTO (TOP), OGETO MWEBI



## SOUTH DAKOTA

## Going Home Again

The smallmouth bass in South Dakota's Lake Francis Case weren't biting, but author **Tom Brokaw** and photographer **Vincent Musi** "had a great time anyway," the NBC News anchor reports. "We both said, 'You know, this isn't a bad way to earn a living.'"

For Tom, returning to Pickstown evoked memories of "a real 19th-century corner of America." He lived there from the age of 7 to the time he was 15. "It was a very vibrant place, and I'm still attached to it," he reflects. "A lot of my interests formed there: fishing, being on the river, Indian affairs. Not much has changed. I stood in the vacant lot where my house had stood, and I could vividly remember it. But it was hard to imagine the arc of



BRYCE BROYHILL

my life from that time to now."

Vince was impressed by Tom's memory. "It was extraordinary," he marvels. "He remembered childhood friends, teachers, houses." Vince also noted the demands being a celebrity imposes: "It's almost impossible for Tom to have a conversation in a

public place; people are always coming up for autographs." After spending a week with the TV newsmen, Vince himself became a fan. "He's a good guy," the photographer says with a grin. "I told him if he ever wanted to quit his day job, Geographic would take him on any day."

## WORLDWIDE

The long and the short of it is this: Photographer **Steve McCurry**, who stands five feet six, was passing a monastery in Machen, Tibet, "and this monk was just there. He was absolutely huge, seven feet tall at least. So



MICHAEL GARROLL

I asked to have my picture taken with him." Joining them for the incongruous portrait was a young monk about eight years old. Steve loved Tibet, for its beauty and for the hospitality of its people. "They invite you into their homes and give you yak butter tea," he says. "I was never refused entrance."

A classroom teacher for 18 years and a longtime consultant in the Society's Geography Education Program, **Cathy Riggs Salter** debuts as an author in the magazine with her article about a newly created map of Lewis and Clark's travels. "The Missouri River still feels wild when you get out on it," she says. "And with this map you can go to a certain spot, and the landscape matches the landscape described in the explorers' journals. You feel as though William Clark is right there at your shoulder."

When spring was still a rumor on the frozen tundra of Victoria Island in the Canadian Arctic, German freelance photographer **Norbert Rosing** watched newborn muskox calves struggle. "Ice crystals were flying and snow was freezing over a little one. I thought it had no chance, but suddenly it was up and hopping around like a goat." Rosing also found the carcasses of three calves that had been separated from their herd and killed by wolves. And he stumbled across a barren-ground grizzly, an animal that occasionally preys on muskoxen. Working in the north since 1988, Rosing has also photographed polar bears, walrus, and the northern lights.

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Photograph by Michael Nichols

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# Flashback



A. L. SHELTON

## TIBETANS

### Hanging in There

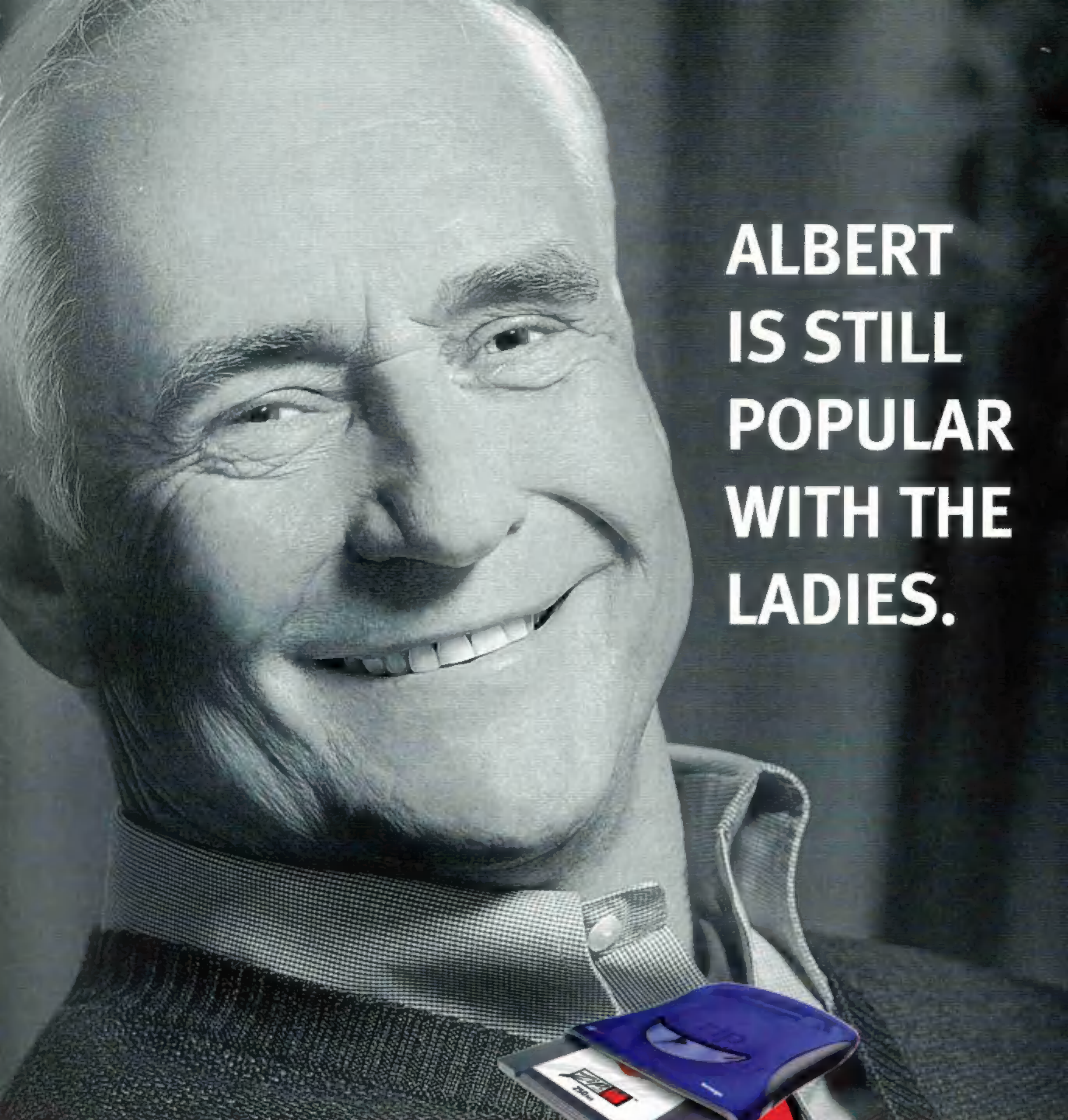
"Throughout the whole region . . . bridges are few and primitive," wrote A. L. Shelton, author of "Life Among the People of Eastern Tibet," from the September 1921 NATIONAL GEOGRAPHIC. This image of a precarious Mekong River crossing was first published in that issue. "With his mount securely trussed to the rope bridge," says the photo's caption, "the owner supplies his own motive power, hand over hand, as he pulls himself and beast across the chasm with the river far below."

A staple of Tibetan food also presented some difficulties, according to Shelton, a medical missionary who had spent several years in the country. "There is such a quantity of yak hair in the butter that an observer would almost assume that it was a prized ingredient," he wrote.

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PAST THE SWITCHBACKS AND INTO  
THE STREAM AND BEYOND THE RIDGES  
TO GRANDMOTHER'S HOUSE WE GO.